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FACULTY OF AGRICULTURE

The undersigned hereby certify that they have read and recommend to the Committee on Graduate Studies for acceptance a thesis on "Soft white spring wheat as an Alberta cereal crop", submitted by A. E. Harper, B.Sc., in partial fulfilment of the requirements for the degree of Master of Science.

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SOFT WHITE SPRING WHEAT AS AN
ALBERTA CEREAL CROP

A. E. Harper

Department of Plant Science

A THESIS

submitted to the University of Alberta
in partial fulfilment of the
requirements for the degree of

MASTER OF SCIENCE

Edmonton, Alberta

April, 1947

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SOFT WHITE SPRING WHEAT AS AN
ALBERTA CEREAL CROP

A. E. Harper

INTRODUCTION

During the past few years soft white spring wheat production has come to occupy a minor role in Alberta agriculture. In the irrigated areas in the southern part of the province, where hard red spring wheat of high quality cannot usually be grown, soft white spring wheat is being tried as an alternative. The acreage seeded to this crop is small compared with the total provincial wheat-growing area. Since there is little likelihood that the market will exceed 1,500,000 bushels a year, soft spring wheat cannot become very important as an Alberta cereal crop, although it may well become important in certain districts.

In order to indicate the position soft white spring wheat occupies in America, a brief review of the United States wheat crop is given.

The United States Department of Agriculture divides wheat into five official classes (7), as follows:

Hard Red Spring Wheat - Constitutes 20% of the United States crop. It is used chiefly for bread flour.

Durum Wheat - Constitutes 5% of the United States crop. It is an extremely hard class and is used almost entirely for macaroni and spaghetti.

Hard Red Winter Wheat - Constitutes 40% of the total United States crop. It is of high bread-making quality.

Soft Red Winter Wheat - Constitutes 30% of the United States crop. It is starchy in character and is used for pastry and home baking.

White Wheat - Comprises the remaining 5% of the United States crop and includes both soft and hard, winter and spring varieties. The flour is well suited to pastry and breakfast foods and may be mixed with hard-wheat flour for bread making.

The major portion of the white wheat grown in both Canada and the United States is soft in character, and is used for the production of cake and pastry flours. Wheat for this purpose must have a low protein content, preferably below 10%. The quantity of protein, however, is not the factor which determines the softness. The quality of the gluten is much more important. The characteristics which determine the quality are hereditary in nature and can be modified only slightly by environment. The extensibility and elasticity of the gluten are the most important of these characteristics. In the hard wheats an extensible, highly elastic gluten is desirable, while in the soft wheats a highly extensible but far less elastic gluten is desired.

Generally speaking then, the gluten of soft wheat is softer, more pliable, and less elastic than that of hard wheat.

Cereal chemists have devised several physical and chemical tests which are designed to evaluate quality and replace the longer, more arduous baking tests. Protein content has been accepted as a very good general indication of wheat quality. Further tests, such as the wheat meal fermentation time, mixogram area, pearling percentage, and the viscosity of a flour-water mixture, have been used to measure the relative softness and gluten strength of soft wheat varieties. No one of these tests by itself gives an adequate evaluation of the wheat being tested, but when the results of all the tests are considered a dependable classification can be made.

In the selection of a variety the quality of the milled product is of importance to both the miller and the baker. The agronomic characters, however, are important to the farmer. In selecting a variety for recommendation both the quality tests and the agronomic factors must be ascertained. When maturation time, yield, straw strength, and grade, are determined, and considered together with the quality tests, a fairly complete picture of the wheat is obtained.

Soft wheat flour is used chiefly for baking cakes, cookies, biscuits, pastries, and pies--home-baked products. Flour from soft wheat is naturally adapted to

these uses and results in a higher quality product (5). It is reasonable, then, to assume that, although the overall demand for cake and pastry flour is small, nevertheless it occupies an important place in the baking industry.

Soft white winter wheat is grown to a considerable extent in eastern Canada and some portions of the eastern United States. In the north-western United States soft white spring wheat is produced quite extensively. Western Canada, however, is primarily a hard red spring wheat producing area and, as a result, little attention has been paid to any other class of wheat. For the most part, Alberta has had to import soft wheat flour from either eastern Canada or the north-western United States. Now, however, since it appears feasible to grow locally a soft wheat which will produce a good quality pastry flour, Alberta may well be expected to meet at least her own requirements for this product and may be able in future years to export a high-grade cake and pastry flour.

In Alberta milling companies have recently been encouraging farmers in the irrigated districts to produce a limited amount of soft white spring wheat. During 1946 approximately 550,000 bushels were grown and a very satisfactory product was milled from this wheat. At present there are no set grade standards for this crop and, to date, no varieties have been registered. Steps are being taken, at the present time, however, to license one variety, Lemhi, and also to

inaugurate special grade standards for soft white spring wheat.

Two years ago this project, supported by a scholarship from the Maple Leaf Milling Company, was begun in order to obtain information regarding the suitability of a number of varieties under Alberta conditions. Previously, the University of Alberta had conducted a breeding program (6) but no intensive study of quality was undertaken, nor was it known how the wheats would react under irrigation. During 1945 the necessary equipment was purchased and a project was organized with the object of testing the quality of a number of promising varieties and crosses of soft white spring wheats under varying conditions throughout the province.

LITERATURE REVIEW

Most of the quality testing work on this continent has been done in connection with the hard, bread wheats and the winter wheats. Testing of the bread wheats is based largely on their performance in baking tests. Although these tests lend themselves very well to an evaluation of hard wheat varieties they have been found highly variable when used as a basis of comparison for soft wheats. The results of such tests have been found to depend upon the individual operator's experience and ability (5). Since it

is desirable to obtain collaborative data, and since there are several recognized physical and chemical tests, these have been accepted fairly widely in place of baking tests as a means of evaluating soft wheats.

The bulk of the work published in this field has been related to individual quality tests, with little emphasis on actual variety testing. Much work has been necessary in order to develop these tests to a point where they may be considered reliable. Difficulties have also been encountered in interpreting the results correctly. Although procedures for many of these tests have been approved by the American Association of Cereal Chemists (1) there is still some doubt as to the interpretation of the values obtained. The tests are discussed in some detail under Materials and Methods.

The University of Alberta, in collaboration with the Central Experimental Farm at Ottawa (3) conducted some preliminary tests on soft spring wheat varieties grown on the black soils and gray wooded soils of Alberta. Agronomic characters were studied and viscosity, protein, and baking tests were conducted at Ottawa.

The variety Dicklow was found to be superior in quality. It was followed by Federation, Pacific Bluestem, Onas, and Federation x Dicklow, in that order. Bunyip and several other varieties were estimated to be too strong for

good soft wheat flours.

There was some indication that a satisfactory soft wheat flour could be produced on the gray wooded soils since the Athabaska test cakes were superior to those of Edmonton and Beaverlodge. Some inconsistency is evidenced, however, since results from Fallis, another gray wooded soils location, gave the poorest results.

Waddell et al (16), in their report on the testing of winter wheat varieties in Ontario, relied to a large extent on physical and chemical tests which could be performed rapidly. They used such tests as protein and ash content of wheat and flour, fermentation time, pearling, mixogram area, and viscosity. Results obtained were considered together with an assessment of the agronomic characters to differentiate some sixteen varieties and crosses.

From the data on agronomic characters the suitability of the varieties to the farmer was readily estimated. Using the data obtained from the physical and chemical tests the varieties were classified according to their suitability to the baker and consumer. Varieties unsuitable for soft wheat flours were separated with ease. The remaining varieties were classified, on the basis of the tests, into three groups: (1) very soft--suitable for pies, cakes, and sweet goods; (2) intermediate--cracker doughing flour, cake, and hard pastry; (3) moderately strong--cracker sponging flour,

for use solely in making crackers.

In a preliminary test of commercially grown wheat, tested by the methods mentioned and then appraised by a milling company for performance, the results were found to be in close agreement. Although it was possible to select the most satisfactory varieties on the basis of the physical and chemical tests, it was suggested that before releasing new varieties a semi-commercial test should be considered.

The United States Department of Agriculture has used these tests widely in appraising both soft winter and soft spring wheats. Fifield et al (4) report results obtained during a period of five years' quality testing of soft white spring varieties. The physical and chemical tests mentioned above were used in conjunction with baking tests. The agronomic characters were also considered. The varieties were grown on both irrigated and non-irrigated land.

Seventeen varieties of soft white spring wheat were tested. On the basis of the tests the varieties Baart, Pacific Bluestem, Idaed, and Union, were the best for cakes, while Dicklow, Lemhi, and Jenkin appeared superior for biscuits. All varieties tested, however, produced satisfactory cakes and cookies.

The statistical analysis indicated a significant correlation between protein content and doughball time, the cooky factor and cake texture. This implies that protein content and doughball time determinations give a measure of

baking performance.

Waddell et al (16) found a significant positive correlation between viscosity, mixogram area, doughball time, and protein content, indicating again that the physical and chemical tests give a measure of baking quality.

Fifield et al (4) report that wheat grown under irrigation had a consistently lower doughball time than did non-irrigated material. Other factors, however, were not considered comparable.

Garnatz (5), reporting to the American Association of Cereal Chemists, states that, on the basis of protein, viscosity, cooky, and cake tests, their laboratory was able to evaluate six samples of flour. Their evaluation agreed very closely with the performance obtained by the biscuit and cracker company utilizing the flours. In a collaborative study with two other laboratories, evaluations were in close agreement.

Garnatz emphasizes the use of the cake baking test as the final criterion in evaluating a flour. Tests, such as the doughball time test, pearling, and mixogram areas, are mentioned as being valuable, enabling the wheat breeder to appraise rapidly the potentialities of varieties under trial.

Baking tests were conducted by Richardson (12) on seven varieties of white spring wheat grown under irrigation at Bozeman, Montana. White Federation produced the best cookies, Lemhi, Erect, Federation, and Irwin Dicklow followed

in that order. Both bleached and unbleached flours were used in cake tests. Using unbleached flour, Baart produced the best cake with Federation second and Lemhi third. With bleached flour Onas produced the best cake, with Lemhi second and Federation third. The data presented indicate that, using commercial flour, slightly better cakes were obtained.

MATERIALS AND METHODS

Materials

Plots

During 1945 and 1946 soft white spring wheat plots were located at five stations in Alberta and one in British Columbia. Twenty-two varieties were grown at Edmonton on black soil, and at Brooks on light brown soil. Ten of the most promising varieties were grown at Fallis on the gray wooded soil, and on two farms in the Brooks irrigated district; (These are designated "Hallman" and "Trimmer".) (Figures 1 and 2); and, through the cooperation of the University of British Columbia, at a point in the Fraser Valley.

The Fallis, Edmonton, and B.C. plots were on dry land, while the three Brooks plots were grown under irriga-

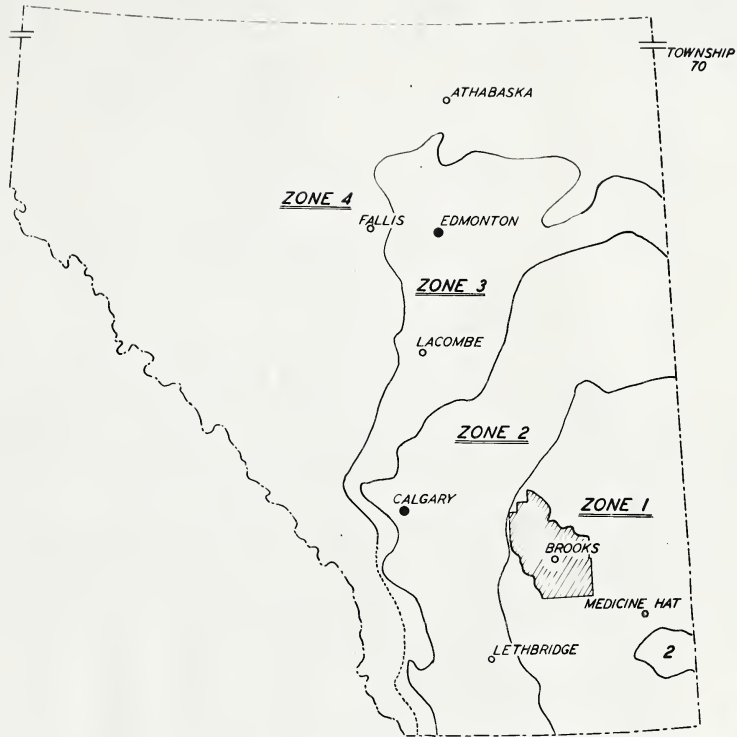


Figure 1

Map of Southern and Central Alberta

Shaded portion indicates Eastern Irrigation District

Plot locations: Brooks - Zone 1, brown soil, irrigated
Edmonton - Zone 3, black soil, non-irrigated
Fallis - Zone 4, gray wooded soil, non-irrigated

Figure 2

MAP

OF THE

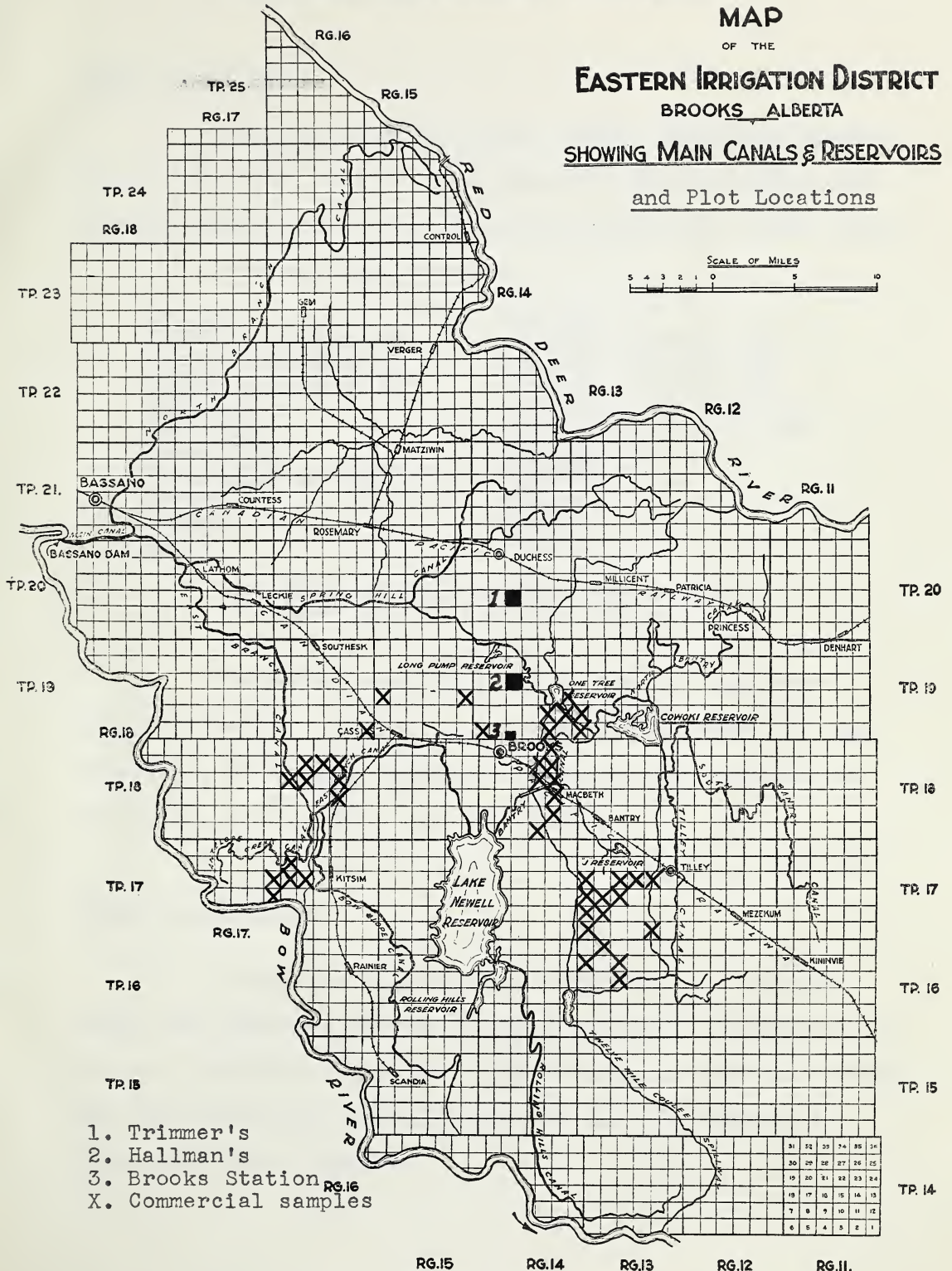
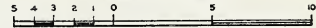
EASTERN IRRIGATION DISTRICT

BROOKS ALBERTA

SHOWING MAIN CANALS & RESERVOIRS

and Plot Locations

SCALE OF MILES



EASTERN IRRIGATION DISTRICT

BROOKS, ALBERTA,

tion.

The plots were set up as simple randomized blocks. Each variety was sown in quadruplicate, the individual replicates consisting of four rod rows spaced nine inches apart.

Varieties tested were:

Bunyip	Onas 41
Bunyip x Dicklow 4*	Prelude x Dicklow 20
Bunyip x Dicklow 8*	Prelude x Dicklow 23
Bunyip x Dicklow 12*	Prelude x Dicklow 28
Dicklow*	(P x D)P x (P x D) 23
Escondido	(P x D)P x (P x D) 24**
Federation	Red Bobs **
Federation x Dicklow*	2780-A*
Idaed*	3216-7
Lemhi*	3226-A
Onas*	3226-B

* grown at all stations both years

** grown at all stations one year

The plots were harvested in the fall and the material brought to Edmonton to be threshed except for the University of British Columbia plot which was threshed in Vancouver and the wheat sent to Edmonton.

Commercial Survey

During the fall of 1946 samples of the variety Lemhi were obtained from 85 farmers scattered throughout the Eastern Irrigation District. Information was obtained as to the crop previously grown on the land and the amount of irrigation water applied.

Irrigation Study

In 1946 a plot was sown at Brooks in an attempt to study the influence of irrigation on protein content. The plot consisted of four replicates of each of eight treatments. Treatments varied from no irrigation to three irrigations during the growing season. Time of applying water was also varied.

Unfortunately, owing to the extremely heavy rainfall in the Brooks district during the summer of 1946, no information on the effect of irrigation was obtained from this plot.

Methods

Agronomic Observations

Prior to harvesting, notes were made on the heights and the relative straw strengths of the varieties appearing in the plots. Straw strength was estimated as a value between one and ten: "one" indicated prone plants, while "ten" indicated upright plants.

During 1946 rust infected the plot at the Brooks Horticulture Station. Observations were made on the relative susceptibility of the various varieties. Comparison was made on the basis of a value of "zero", indicating no

rust, and "ten" indicating heavy infection.

At Edmonton it was possible to measure the period of growth. In both 1945 and 1946 values were obtained indicating the number of days required for each of the twenty-two varieties to reach maturity.

After threshing had been completed, yield and bushel-weight were measured for each sample. Each sample was graded by the Western Grain Inspection Office, Edmonton.

Laboratory Work

The quality tests were carried out in the laboratory of the Department of Plant Science at the University of Alberta, Edmonton. Ten samples from each of Fallis, the Brooks Horticulture Station, and one of the other irrigated plots were sent to Guelph where Mr. W. H. Waddell of the Ontario Agricultural College ran pearling tests, doughball times, and mixogram areas on them.

All samples were milled on an Allis-Chalmers experimental mill. Protein (1) determinations were run on both the wheat and flour. Ash (1) determinations were run on both the wheat and flour of the 1945 crop.

A doughball time, pearling index, mixograph curve, viscosity test was run on each sample of each variety. Baking tests were done to compare the Brooks, Edmonton, and Fallis samples.

Doughball Time Test (2,16) or Wheat Meal Fermentation Time

To a 10-gram sample of wheat which had been finely ground was added 5.5 ml. of a yeast solution. The yeast solution consisted of 10 gm. of compressed yeast to 100 ml. of water. The wheat sample to which the yeast solution had been added was mixed in a beaker to medium consistency. It was then rolled into a doughball and dropped into a beaker containing 80 ml. of water at 80°F. After a few minutes the ball rises to the surface, remains there for some time, then disintegrates and sinks to the bottom of the beaker. The number of minutes which elapse from the time the doughball is dropped into the beaker until it begins to disintegrate is a measure of the gluten strength of the sample of wheat.

During 1945 the constant temperature cabinet was maintained at 30°C., while during 1946 a temperature of 80°F. was used. Times were shorter with the higher temperature, but the results appeared to be more consistent (Figure 3).

Pearling Index (8)

The pearling test was run on a Strong-Scott barley pearler. The sample of 20 grams of wheat was pearled between a large, rapidly revolving stone and a coarse screen (10 mesh, .047" wire, double crimp (14)). Most of the grinding is done by the screen. The sample is pearled for one minute with the stone rotating at approximately 1800

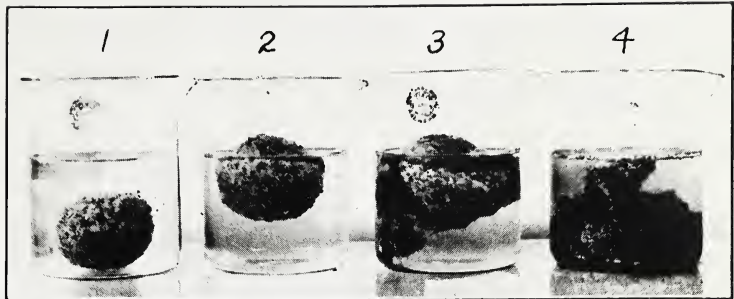


Fig. 9. Behavior of a doughball from a soft wheat. 1, doughball just immersed when time is first recorded. 2, doughball 20 to 30 minutes later. 3, the first piece of dough has just split off. At this stage the time is again recorded. 4, doughball 10 to 15 minutes later when it has disintegrated and completely fallen apart.

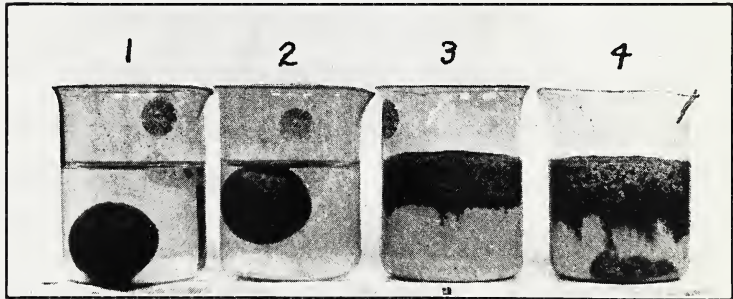


Fig. 10. Behavior of a doughball from hard spring wheat. 1, doughball just immersed when time is first recorded. 2, doughball 20-30 minutes later. 3, the first piece of dough has just detached itself and is still hanging like a small tassel to the under surface. At this stage the time is again recorded. 4, doughball three or four hours later in slow process of disintegration.

Figure 3

The wheat meal fermentation (Doughball) time test

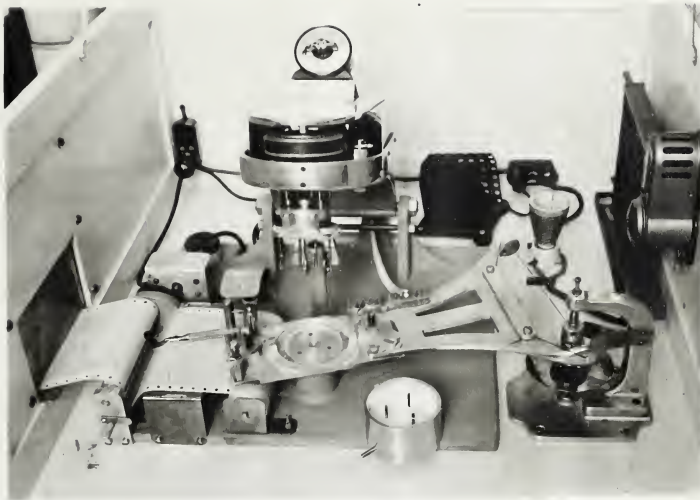
(After G. H. Cutler and W. W. Worzella, Circ. 218, p.10,
Purdue Univ. Ag. Exp. Sta., Lafayette, Ind., 1936).

revolutions per minute, then removed and weighed. The loss in weight indicates the physical hardness of the wheat sample. A high pearling index indicates a soft wheat.

Mixograph Curves (9, 13, 15)

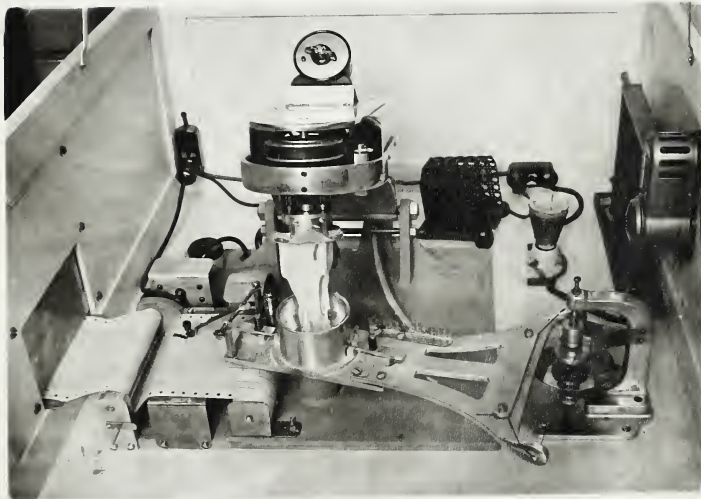
These curves were made on a Recording Mixograph. The basic principle of this instrument is that the torque developed during the mixing of flour into dough can be measured and recorded graphically. The flour and sufficient water to bring the sample to optimum absorption are placed in the mixing bowl to which is attached an arm. This arm rocks back and forth but is restricted in its motion by a spring. The oscillations during mixing are recorded on a roll of graph paper which is moved forward at a constant rate by a synchronized motor. The height and shape of the curve indicate the type of gluten of the flour used. The area under the curve is measured by means of a planimeter. This area, according to Morris et al (9, 10), gives a good correlation with other physical measurements of soft wheat flours.

The flour sample in these determinations consisted of 35 grams weighed on a 15% moisture basis. Optimum absorption for the samples was taken as 60 % (15) (Figure 4).



Mixograph with bowl removed. Flour has been placed in the bowl. In the upper right-hand corner can be seen the fan, heating element, and thermostat.

Figure 4



Mixograph with mixing head lifted before completion of the curve. The dough mass can be seen clinging to the mixing head. A portion of the curve can be seen at the left. On the movable arm immediately to the right of the bowl can be seen notches for adjusting the tension of the spring.

Apparent Viscosity (1)

These tests were run on a MacMichael Viscometer. A flour-water suspension to which has been added a quantity of lactic acid is placed in a bowl and the whole rotated about a disc suspended by a fine wire. The wire is attached to a circular indicator which turns with the wire as torque is developed. The friction of the flour-water suspension revolving about the disc tends to twist the wire. A stationary pointer shows on the circular indicator the extent of rotation. The reading is expressed in degrees MacMichael. Strong flours have a high viscosity reading.

No digestion period was used in these determinations and the lactic acid (7 ml.) was added at one time instead of in one- and two-ml. increments (17). This method makes possible a comparison with commercial results(Figure 5).

Baking Tests

A few cake-baking tests were conducted to determine the comparative baking quality of Bunyip x Dicklow (an Edmonton cross), 2780-A, and Lemhi. One sample of each of the three varieties from Edmonton, Brooks, and Fallis, was baked according to a standard formula supplied by the Maple Leaf Milling Company (6).

The formula is as follows:



Figure 5

MacMichael Viscometer

As the bowl rotates the friction from a suspension in the bowl causes the disc and the wire from which both the disc and the indicator dial are suspended to twist. Stationary pointer at top indicates ϕ_M on the dial. Disc can be seen in correct position in bowl.

Standard Cake Formula

1. Flour - 320 grams
Shortening - 165 grams
Cream on low speed for 3 minutes; scrape bowl at end of 2-minute interval, and at end of 3rd minute.
2. Sugar - 390 grams
B. Powder - 20 grams
Salt - 12 grams
Milk, liquid - 120 grams
Sift sugar, b. powder and salt together. Add to 1 and add milk quickly, taking 1 minute in all. Scrape again at end of 1 minute and again at end of 3rd minute. Low speed.
3. Egg white - 220 grams
Milk, liquid - 130 grams
Stir eggs and milk together (do not beat). Add $\frac{1}{2}$ of this mixture and mix for 1 minute. Low speed. Scrape bowl at end of minute and mix $\frac{1}{2}$ minute.
4. Add balance of egg and milk mixture and mix $\frac{1}{2}$ minute. Scrape bowl and finish with $1\frac{1}{2}$ minute mixing on second speed (Hobart mixer). Do not scrape.

The above batter should be now scaled into 8" x 8" x 2" pans (600 grams per pan), and the air bubbles removed by dropping the pans several times from a height of about four inches to the bench top.

Batter is now ready for the oven and should be baked at approximately 325 to 350F. for 20-25 minutes. Best baking temperature and length of bake, of course, vary with the oven used, and must be determined by the individual operator to suit his particular oven conditions.

Commercial Survey

Protein determinations were made on the samples obtained. The data were classified according to soil type and previous crop and the results were averaged. An attempt was made to determine the influence of soil type and previous crop on protein content.

The plot results and information obtained from the Maple Leaf Milling Company as to protein content of their commercial wheat were also taken into consideration in this study of environmental factors influencing quality.

EXPERIMENTAL RESULTS

Varietal Tests

The results presented in this section include the data for agronomic, physical, and chemical determinations described in the section on methods. The values in Table I are the two-year means for twenty-two varieties grown at Edmonton and Brooks. The values in Table II are the two-year means for six stations. Foot notes to the tables explain missing values and any other discrepancies. Since the comparative results for both stations and years are similar, only the means are included in the body of this thesis. The individual station results are tabulated in Appendix Tables I to XIX.

Environmental conditions influence the results of some of the determinations quite extensively. Soil and moisture variations of the different plot locations appear to influence yield, protein content, doughball time, mixogram

TABLE I

SOFT WHITE SPRING WHEAT - 1945-46

Mean values for agronomic characters and physical and chemical quality tests for Brooks and Edmonton for two years

	Straw strength	Height (in.)	Rust ¹	Days to maturity ²	Weight per bu. (lb.)	Yield (bu./ac.)	Grade	Wheat protein (%)	Doughball time (min.)	Pearling (%)	Mixogram area (sq.in.)	Viscosity ⁶ °M	Milling yield (%)	Flour protein (%)	Flour ash ³ (%)	Wheat ash ³ (%)
Bunyip	8.0	41	9.0	112	64.4	39.3	2.0	13.2	46	67.7	10.91	99	56.7	11.8	.45	1.49
Bunyip x Dicklow 4	7.5	42	5.5	113	65.1	49.2	2.5	12.0	33	67.7	9.44	82	55.2	10.6	.41	1.31
Bunyip x Dicklow 8	8.5	38	4.5	113	64.8	53.1	2.0	11.5	32	63.2	8.90	83	57.0	10.8	.39	1.29
Bunyip x Dicklow 12	8.0	40	6.0	117	64.8	53.2	2.0	11.7	31	67.0	9.29	97	54.3	10.3	.39	1.35
Dicklow	7.0	42	6.0	118+	60.2	51.5	3.5	11.6	30	62.7	9.61 ⁴	—	56.7	—	.38	1.24
Federation 41	9.0	38	3.0	116	63.6	46.0	3.0	11.8	38	70.9	10.17	117	55.7	11.4	.42	1.42
Federation x Dicklow	8.0	40	3.0	115	64.4	54.5	3.0	11.7	32	65.3	10.19	100	55.4	10.9	.38	1.38
Escondido	7.0	39	8.0	107	64.5	39.7	2.0	14.4	44	64.6	10.50	113	53.4	11.8	.43	1.44
Idaad	8.0	36	9.0	105	65.1	42.2	2.0	13.2	48	79.5	10.92	118	58.3	11.4	.36	1.41
Lemhi	8.0	40	4.0	111	64.8	56.4	2.0	12.4	31	68.1	10.59	115	56.1	10.6	.38	1.31
Onas	8.0	38	4.0	115	63.6	44.4	3.0	11.8	45	71.4	8.29	106	51.1	10.4	.42	1.37
Onas 41	9.0	39	2.0	114	63.8	49.5	3.0	11.8	48	69.1	9.38	97	52.8	10.8	.49	1.38
Prelude x Dicklow 20	7.0	39	8.5	107	64.1	32.6	2.0	13.2	52	78.1	9.31	116	58.6	11.0	.38	1.43
Prelude x Dicklow 23	7.5	41	9.0	107	64.5	41.3	2.0	14.1	58	58.2	11.27	154	59.0	12.5	.48	1.46
Prelude x Dicklow 28	6.0	40	7.5	109	64.8	42.4	2.0	15.0	46	72.5	12.99	136	50.0	13.6	.41	1.45
(P x D)D x (P x D) 23	6.5	43	5.0	108	63.2	37.3	2.0	13.8	38	56.7	11.68	157	53.9	12.4	.40	1.49
(P x D)D x (P x D) 24	8.0	40	6.5	110	63.8	45.4	2.0	13.2	39	70.0	9.93	108	55.4	11.9	.38	1.42
Red Bobs ⁵	8.5	41	7.0	108	64.9	40.0	2.0	14.0	74	55.7	—	187	63.0	13.5	.39	1.35
2780-A	7.0	45	1.5	112	65.2	49.4	2.0	13.3	68	65.1	12.68	146	54.3	12.4	.41	1.32
3216-7	8.0	43	1.5	115	64.2	46.4	1.5	13.7	55	57.9	12.00	148	59.1	11.9	.37	1.42
3226-A	7.5	44	2.5	116	63.9	48.0	2.0	13.4	56	66.3	11.68	146	55.5	11.6	.40	1.42
3226-B	8.0	43	2.0	117	63.8	46.5	2.0	13.6	46	68.0	11.59	149	57.0	12.1	.41	1.42

NOTES:

- 1 Data from Brooks Station 1946
- 2 Data from Edmonton only
- 3 Data for 1945 only
- 4 Brooks value missing 1946
- 5 Red Bobs is a hard spring variety
- 6 Data for 1946 only

TABLE II

SOFT WHITE SPRING WHEAT - 1945-46

Mean values for agronomic characters and physical and chemical quality tests for six stations⁷ for two years

	Straw strength	Height (in.)	Rust ¹	Days to maturity ²	Weight per bu. (lb.)	Yield (bu./ac.)	Grade	Wheat protein (%)	Doughball time (min.)	Pearling (%)	Mixogram area (sq. in.)	Viscosity ⁸ °M	Milling yield (%)	Flour protein (%)	Flour ash ³ (%)	Wheat ash ³ (%)
Bunyip x Dicklow 4	7.0	40	5.5	113	64.0	53.7	3.0	10.6	35	68.7	8.49	73	56.1	9.1	.46	1.42
Bunyip x Dicklow 8	9.0	37	4.5	113	63.7	53.0	2.5	10.3	32	67.4	8.41	68	55.9	9.3	.44	1.43
Bunyip x Dicklow 12	9.0	37	6.0	117	63.8	55.5	2.5	10.7	32	67.5	8.30	76	54.5	9.1	.44	1.46
Dicklow	8.0	41	6.0	118+	59.3	55.6	4.0	10.2	30	68.6	8.34 ⁶	--	54.9	8.9	.43	1.43
Federation x Dicklow	8.0	35	3.0	115	63.0	56.9	2.5	11.0	34	68.2	9.08	83	54.2	9.5	.46	1.50
Idaed	8.0	39	9.0	105	64.1	48.2	2.0	12.1	49	77.9	9.69	104	55.1	10.2	.42	1.54
Lemhi	7.5	39	4.0	111	63.1	62.2	2.5	10.8	34	69.5	8.53	77	55.2	9.0	.44	1.43
Onas	8.0	38	4.0	115	62.6	54.0	3.0	10.7	45	69.9	8.15	73	52.8	9.3	.48	1.48
(P x D)D x (P x D) 24 ⁴	8.0	39	6.5	110	63.2	46.4	2.0	11.7	43	67.7	9.16	74	55.0	10.4	--	--
Red Bobs ⁵	8.5	39	7.0	108	65.0	41.4	2.0	13.4	69	55.5	--	--	61.5	12.9	.48	1.48
2780A	7.5	44	1.5	112	64.1	56.6	2.0	12.6	58	66.1	10.40	103	53.7	10.3	.50	1.48

- NOTES: 1 Data for Brooks Station, 1946
2 Data for Edmonton, 1945, 1946
3 Data for 1945
4 Grown at Brooks and Edmonton only, 1945
5 Grown at Brooks and Edmonton only, 1946 (Red Bobs is a hard red spring variety)
6 Three irrigated plots missing for 1946
7 One irrigated plot (Trimmer's) missing for 1945
8 Data for 1946

area, and viscosity. Although the order remains practically unchanged from station to station, the station means vary greatly (Appendix Tables VII, X, XIII, XVII, XVIII). The highest yields were obtained under irrigation in the Brooks district with lower yields on the dry land at Edmonton and Fallis. The lowest protein content occurred at Fallis on the gray wooded soils, while the irrigated plots at Brooks and the dry land plot at Edmonton were somewhat higher. The plots which received a large amount of irrigation water gave the lowest protein values of the latter group. Doughball times and mixogram areas were highest at Edmonton with the Fallis and Brooks irrigated samples giving lower results. Edmonton also gave the highest viscosity values, the irrigated stations intermediate, and Fallis lowest.

During milling it was observed that samples from the gray wooded soils sifted very slowly through the finer silks. No immediate explanation has been found for this, but the flour appeared to be "sticky" in its behavior.

The results which were used most extensively in evaluating the varieties were days to maturity, yield, grade, protein content, doughball time, mixogram area, and viscosity.

All varieties were satisfactory for straw strength, height, and weight per bushel. Only when exposed to very strong winds did any of the varieties lodge. All varieties

were sufficiently high to combine. In only a very few instances where the plots were harvested before the grain had completely ripened, did the weight per bushel fall below sixty pounds.

Dicklow required over 118 days to ripen and in very few instances was mature grain obtained. Bunyip x Dicklow 12, Federation, Federation x Dicklow, Onas, 3216-7, 3226-A, and 3226-B required from 115 to 117 days to mature. All of these were considered late for average Alberta conditions. Idaed, Escondido, the Prelude x Dicklow selections, and Red Bobs (hard red variety) matured in approximately 108 days. The other varieties were intermediate. Lemhi and two of the Bunyip x Dicklow selections fell into this group.

Lemhi was the highest yielding variety, averaging consistently higher than the others. Bunyip, Escondido, Idaed, and the Prelude x Dicklow selections were all comparatively low in yield. The Bunyip x Dicklow selections, Federation, Onas, Onas 41, 2780-A, 3216-7, 3226-A, and 3226-B were intermediate. Although they were somewhat lower than Lemhi, the yields were considered satisfactory.

With the exception of Onas, Onas 41, Dicklow, Federation, and Federation x Dicklow which graded three, the average grade was two. The grades were based on characteristics other than quality and variety, the most important factor being the appearance of the kernels. On the basis used, two was considered a satisfactory grade for soft white

spring wheat.

The protein content of the varieties varied greatly. The protein content of the Prelude x Dicklow selections, Escondido, Idaed, Bunyip, 2780-A, 3216-7, 3226-A, and 3226-B was almost as high as that of the hard variety Red Bobs. It was too high for cake and pastry flour. Dicklow, the Bunyip x Dicklow selections, Onas, and Lemhi, were considerably lower. The Brooks-Edmonton mean for the more satisfactory varieties was 11.5 to 12.0%, while the five-station average was about 10.5%. This latter value approximates the results obtained with the commercial samples and is a reasonably satisfactory figure.

The doughball time test results place the varieties in approximately the same order as do the protein results. The Prelude x Dicklow selections, Escondido, Idaed, Bunyip, 2780-A, 3216-7, 3226-A, and 3226-B, all have a long time and presumably a tough gluten. Onas, despite its low protein, also had a long doughball time. Dicklow, the Bunyip x Dicklow selections and Lemhi were low in doughball time, indicating a soft gluten.

The pearling results were of little value in distinguishing varieties that appeared similar in general quality. Apparently the main value of this test is in the separation of hard wheats from soft ones. The pearling percentage for the hard variety Red Bobs was 55.7, while the soft varieties ranged between 65 and 80%. It is interesting to note that

Idaed which showed some hard wheat characteristics in the results of all other tests gave a high pearling percentage indicating softness.

No great differences were observed between the flour yields of the varieties. The flour yields varied from 50 to 60% but, owing to the type of mill and the large human element in the method of milling, it was impossible to place the varieties on the basis of flour yield.

Only minor differences in wheat ash occurred and the differences on the basis of flour ash were even smaller and less consistent. It appeared possible to keep the ash content of the flour between .40 and .44%, which is considered suitable for soft wheat flour. A few varieties were slightly above this value but this was considered due to the milling method rather than to the variety.

The mixogram areas placed the varieties in much the same order as did protein and doughball time. Again the Bunyip x Dicklow selections, Dicklow, Lemhi, and Onas, gave the lowest values. Onas 41 and Prelude x Dicklow 20 gave favorable mixogram areas. None of these had areas larger than 10.00 square inches. The remaining varieties were all above 10.00 square inches, indicating varieties much harder--probably too hard under Alberta conditions. Figures 6, 7, and 8 illustrate varietal and environmental variations in mixograph curves.

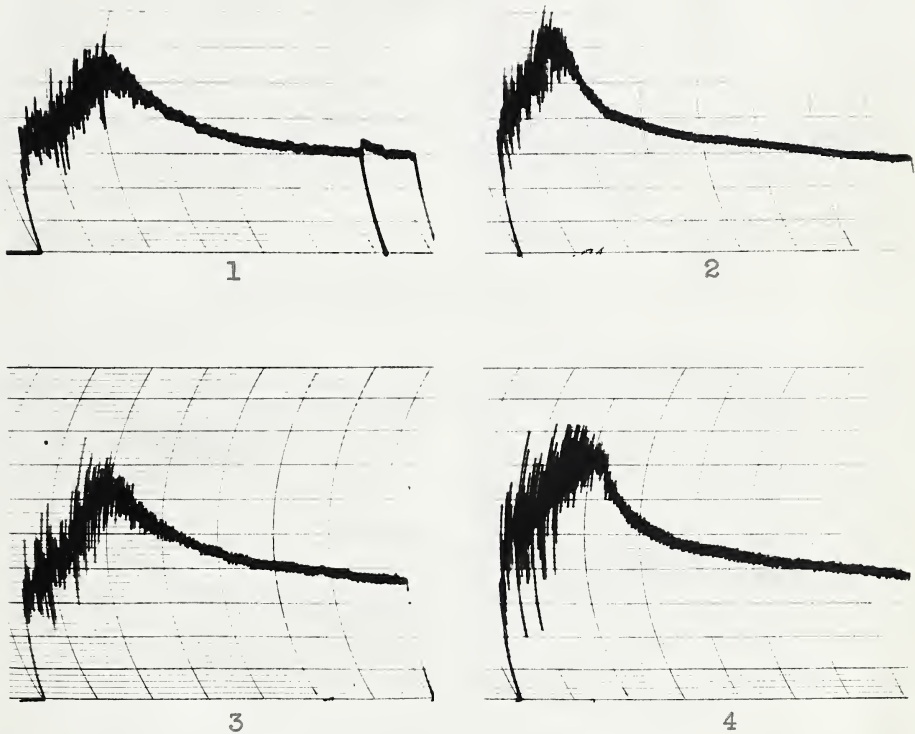


Figure 6

Mixograph curves showing varietal differences for four varieties of soft spring wheat grown under irrigation, 1946. Note variations in areas under curves.

1. Bunyip x Dicklow 8 - 8.61 sq. in.
2. Lemhi - 8.72 sq. in.
3. Idaed - 10.21 sq. in.
4. 2780-A - 11.59 sq. in.

(Distance between curved lines represents 1 minute)

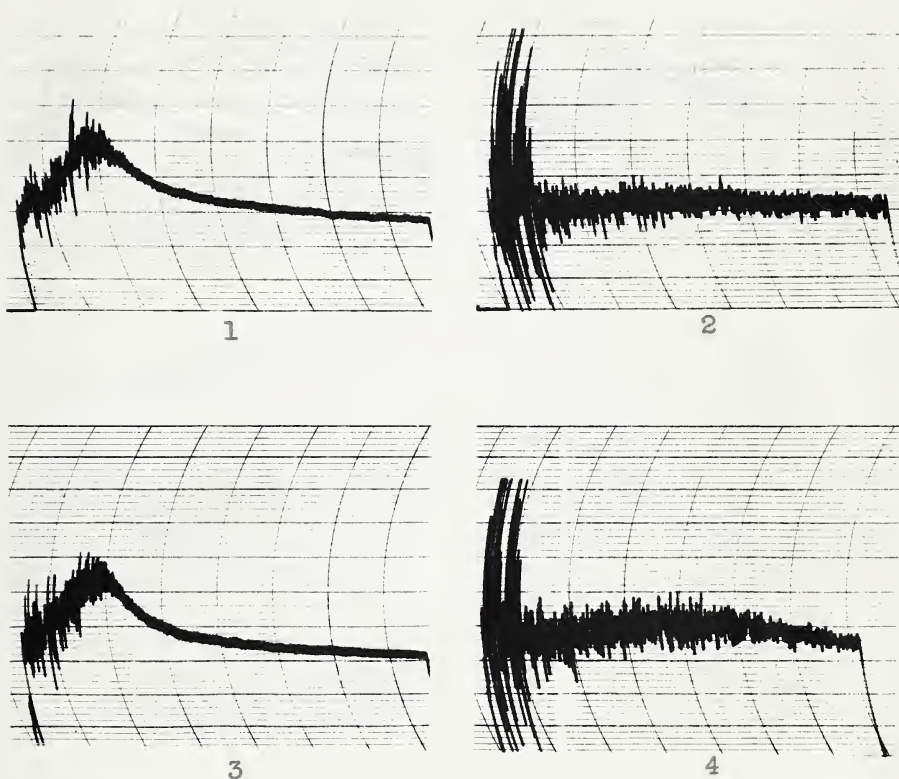


Figure 7

Mixograph curves showing variations
at Fallis for two years

1. Lemhi, 1945:	Protein content	- 11.7%;	Area	- 8.08 sq. in.
2. Lemhi, 1946:	" "	- 7.0%;	"	- 7.38 sq. in.
3. 2780-A, 1945:	" "	- 12.0%;	"	- 8.90 sq. in.
4. 2780-A, 1946:	" "	- 8.0%;	"	- 8.87 sq. in.

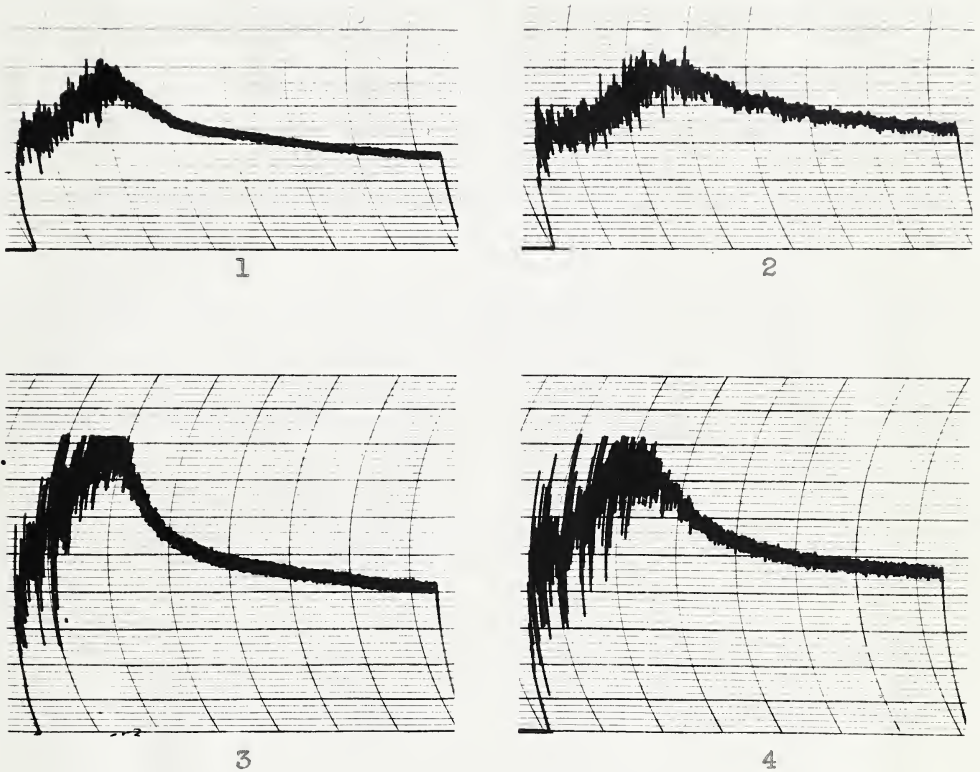


Figure 8

Mixograph curves showing station variations
for the variety 2780-A for 1946

1. Trimmer	- 7.59 sq. in.
2. U.B.C.	- 8.92 sq. in.
3. Brooks Station	- 12.16 sq. in.
4. Edmonton	- 12.82 sq. in.

The viscosity results were generally higher than was expected. Some of the values obtained placed the varieties in slightly different order from that of the other tests. This was particularly true of the Brooks-Edmonton mean values. The Bunyip x Dicklow selections, Federation x Dicklow, Onas, Onas 41, and (P x D)D x (P x D) were consistently lower. Lemhi, although it appeared intermediate on the basis of the two-station mean, fell into the lower group on the basis of the six-station mean. The remaining Prelude x Dicklow selections, Idaed, 2780-A, 3216-7, 3226-A, and 3226-B, gave high viscosity values.

Baking Tests

A few preliminary baking tests were run on Bunyip x Dicklow 8, Lemhi, and 2780-A. Nine samples of unbleached flour were used, three from each of Edmonton, Fallis, and one irrigated station. Although all the samples gave cakes that were quite good, nevertheless certain distinctions were readily observed.

The samples from the Brooks irrigated plot were superior in texture and appearance to those of the other two stations. There appeared to be little to choose between the Edmonton and Fallis samples. This evidence indicates that the most satisfactory soft spring wheat can be grown under

irrigation. There are some grounds, however, for believing that at least in certain years and under certain not too definitely known conditions a fairly good grade of flour may be obtained from wheat from the gray wooded soils.

Cakes from the variety Lemhi were finer textured and presented a better appearance than either Bunyip x Dicklow or 2780-A cakes. There was a tendency for 2780-A to be coarser and less even than the other two varieties.

The collaborative quality data are tabulated in Appendix Tables I, II, III. The pearling percentages obtained at Guelph are about half as high as those obtained at Edmonton but the order is fairly constant. Some variations may also be noted in mixogram areas and doughball times. The consistent pearling and mixogram differences may well be explained by mechanical differences in the Guelph and Edmonton apparatus. Much of the variation in doughball times may be accounted for by temperature variations. During 1945 the tests were carried out at 80°F. at Guelph while 86°F. was used at Edmonton. This resulted in a lower time for the Edmonton values. The following year the Edmonton temperature was reduced to 80°F.

Lemhi stands out as the most promising variety under Alberta conditions. The Prelude x Dicklow selections, Escondido, and Idaed, although they have short growing seasons, are low in yield. They are hard in gluten, as indicated by their long doughball times, and have large mixogram

areas, high proteins, and high viscosities. 2780-A, 3216-7, 3226-A, and 3226-B, have long growing seasons and have the hardest gluten quality. Dicklow has excellent quality but is difficult to mature. Federation and Federation x Dicklow have good quality but again are difficult to mature. Bunyip also exhibits a hard gluten. Lemhi, Onas, and the Bunyip x Dicklow selections all appear to have good quality. Onas has a longer growing season than Lemhi, a longer doughball time, and is consistently one grade lower than Lemhi. It also yields less. The Bunyip x Dicklow selections also require longer to mature. They have, however, good gluten quality and low protein.

On the basis of this work it has appeared advisable to recommend Lemhi for licensing in Canada. It also appears advisable to encourage further breeding work in order to develop an earlier, high quality variety.

Commercial Survey

The data from the classification of the commercial samples on the basis of previous crop are given in Table III.

These data are not very extensive but there is an indication that protein content of soft spring wheat is higher when the crop is grown after alfalfa. Peas, on the other hand, seem to exert little influence on the protein

content of the succeeding crop, apparently not building up a large supply of nitrogen in an available form. The high protein after row crops was obtained from only two samples and cannot be accepted as conclusive. It may, however, be the result of fertilizing practices.

TABLE III

Mean protein content (%) of commercial samples
classified according to previous crop - 1946

	Previous crop						Average
	Cereals	Flax	Peas	Fallow	Alfalfa	Row crops	
No. of samples	17	8	13	24	8	2	72
Average protein, %	9.5	9.6	9.4	9.5	10.8	11.7	9.7

Table IV gives the results obtained when the commercial samples were classified on the basis of soil type, as designated by the University of Alberta Soil Survey maps.

From these results it can be seen that the protein content of the soft spring wheat decreases as the soil becomes heavier. Again, although only one year's results are available and the number is not large, there is a definite trend toward lower protein on the heavier soils.

This decrease in protein content may well be due to the increased moisture-holding capacity of the heavier

TABLE IV

Mean protein content (%) of commercial samples
classified according to soil type - 1946

	Soil type				
	Fine sandy loam	Loam	Silt loam	Clay and clay loam	Silt loam - alfalfa
No. of Samples	7	11	54	4	46
Average protein, %	10.1	10.4	9.6	8.6	9.3

soils. It has been observed that, under conditions of ample moisture supply, protein content is generally lower than when moisture is limiting. This is also substantiated by the results from Hallman's and Trimmer's plots. Both plots are in the irrigated area, both received two irrigations at approximately the same time, and both were seeded on the same day and harvested on the same day. It may be seen from Table V that a much lower average protein content was obtained from the plot on heavy soil than from the lighter one.

In Table IV it may be observed that all the samples after alfalfa were obtained from silt loam soil and that when these were removed from the total the mean protein for silt loam was reduced by 0.3%.

During the study of commercially grown samples it

TABLE V

Mean protein content (%) from two irrigated plots of different soil type - 1946

Plot	Hallman	Trimmer
Soil type	Light	Heavy
Mean protein, %	12.3	9.4

was observed that the protein content of these samples was consistently lower than that of plot-grown material. The average protein content of the 71 commercial samples of Lemhi obtained during the fall of 1946 was 9.7%, while many of the plot values were as high as 11%. The higher value from plot samples is, in all probability, the result of decreased weed competition and increased spacing.

These results are borne out by the Maple Leaf Milling Company's protein analysis of carload lots. With very few exceptions the protein content of cars of Lemhi and Onas were below 10.5%. Idaed, on the other hand, was in no instance below 10.0%.

Irrigation Study

The results of the determinations of protein content of the samples from the plots which received varying

irrigation treatments were disappointing. No significant differences in protein content were obtained. This, as has been previously mentioned, was to be expected since the Brooks district received optimal rainfall throughout the growing season.

In view of this failure an attempt was made to use the results from the variety yield plots over the two-year period to determine whether irrigation had affected the protein content of the wheat.

Table VI gives the results observed.

TABLE VI
Mean protein content (%) from irrigated plots

	Plot			
	1945		1946	
	Brooks	Hallman	Brooks	Hallman
Irrigations	1	2	3	3
Mean protein content	13.9	11.5	12.6	12.6

The plots at the Brooks Horticulture Station and at Hallman's were situated on similar soil. During 1945 Hallman's received considerably more water than did the Brooks Station plot. The mean protein content of the wheat from Hallman's was 2.4% lower than that from the Brooks

Station. During 1946 both plots received similar amounts of moisture and that year the protein contents were similar. It may also be noted that a reduction occurred in the mean protein from Brooks when increased moisture was received. The increase in the Hallman mean protein content for 1946 may be accounted for partially by the fact that this plot was located on land previously in row crops.

Although the evidence is again not conclusive, it indicates that a reduction in protein content may be expected as a result of applying irrigation water when moisture is limiting.

INTERRELATION OF QUALITY CHARACTERISTICS

Correlation coefficients were calculated for the more important quality interrelations. The values are presented in Tables VII and VIII. Scatter diagrams with regression lines to illustrate three of the distributions obtained are presented in Figures 9 and 10.

Correlation coefficients in Table VII were calculated on the means of the 22 varieties grown at Edmonton and Brooks for two years. Highly significant coefficients were obtained for the correlation of protein content with each of doughball time, mixogram area, and viscosity; for mixogram area with each of doughball time and viscosity; and for

TABLE VII

Correlation coefficients between the quality
determinations on 22 varieties
Two stations, two years

	Doughball time	Pearling, %	Mixogram area	Viscosity*
Wheat protein, %	0.596	-0.171	0.772	0.783
Doughball time		-0.201	0.554	0.597
Pearling, %			-0.244	-0.217
Mixogram area				0.853

* Viscosity values for one year only.

Significance of correlation coefficients: 1% = 0.549
5% = 0.433

except viscosity: 1% = .575
5% = .456

TABLE VIII

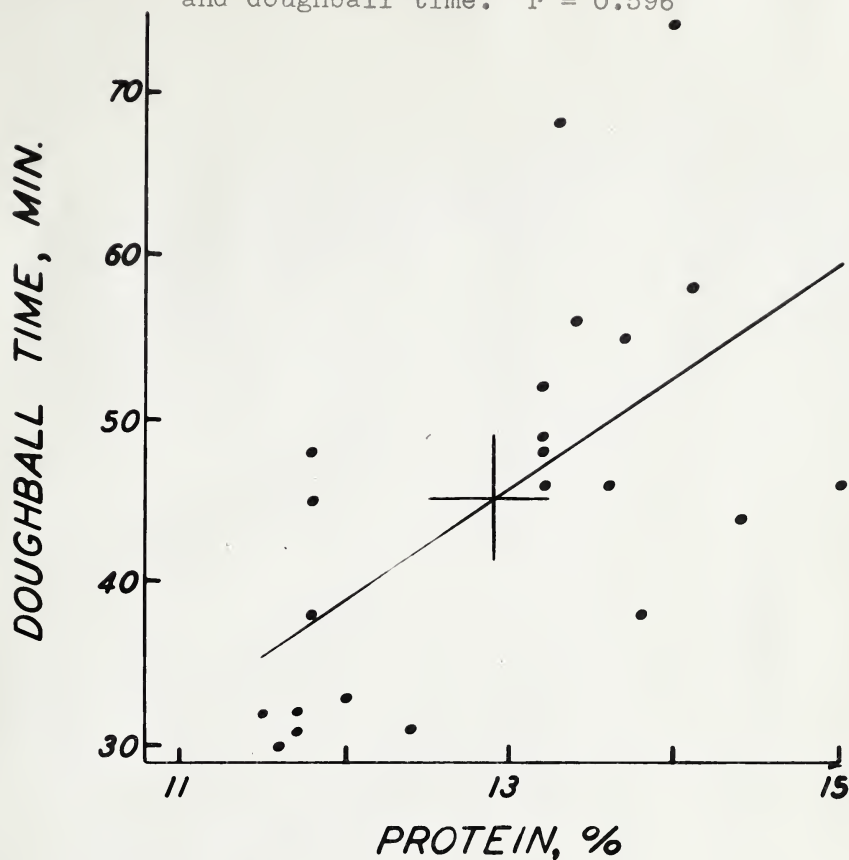
Correlation coefficients between the quality
determinations on 10 varieties
Six stations, two years

	Doughball time	Pearling, %	Mixogram area	Viscosity*
Wheat protein, %	0.900	0.305	0.950	0.732
Doughball time		0.026	0.801	0.707
Pearling, %			0.189	0.690
Mixogram area				0.937

* Viscosity values for one year only.

Significance of correlation coefficients: 1% = .798
5% = .666

Scatter diagram with regression line for protein %
and doughball time. $r = 0.596$



Scatter diagram with regression line for protein %
and mixogram area. $r = 0.772$

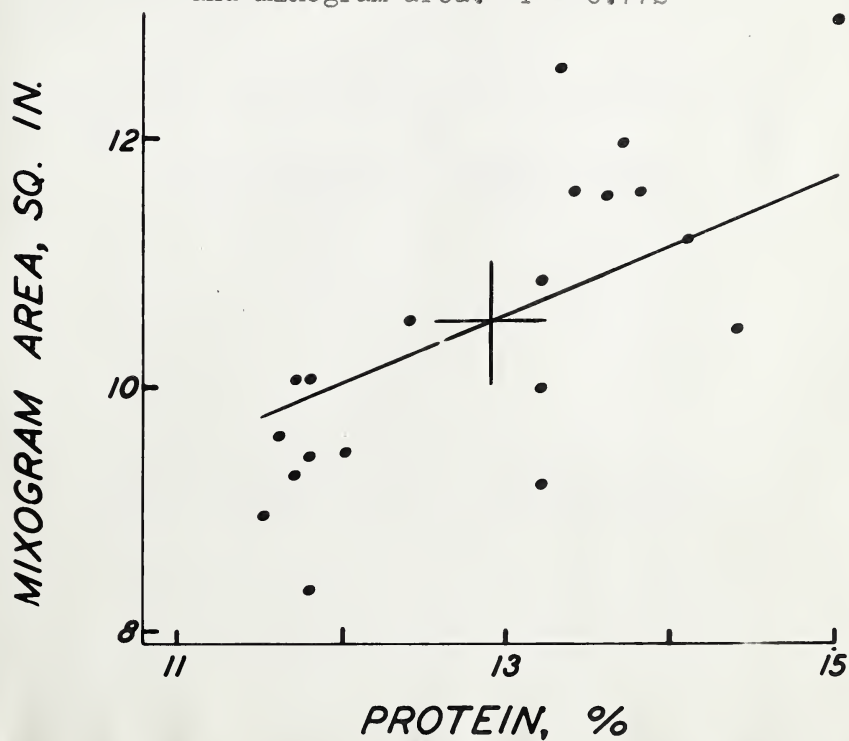


Figure 9

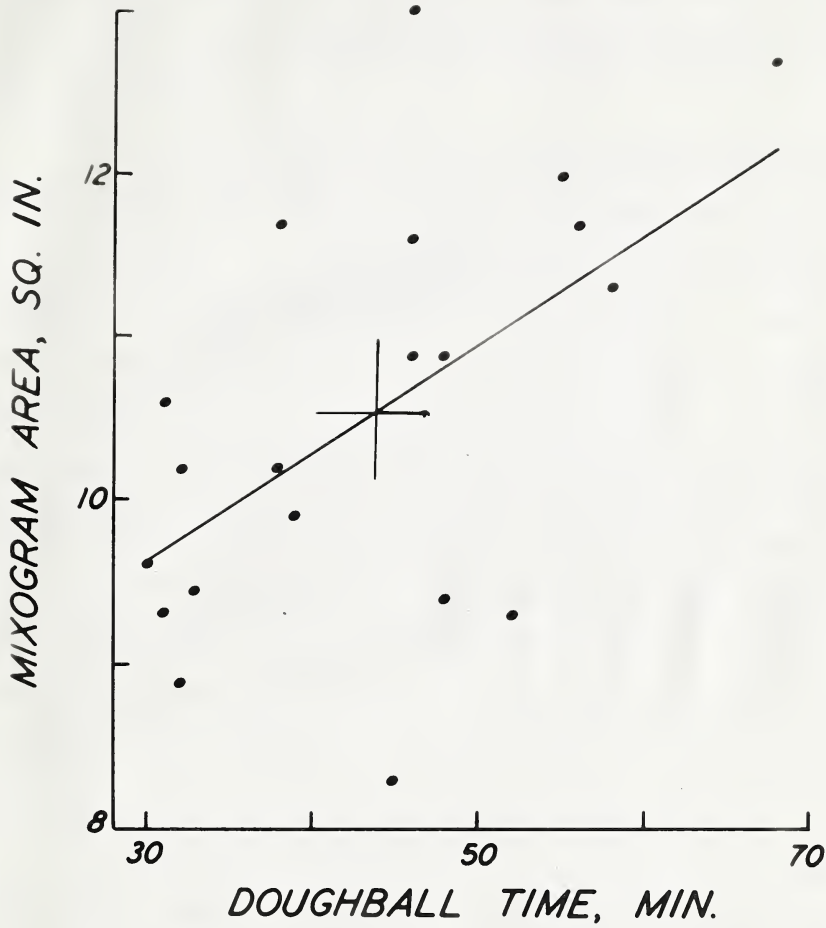


Figure 10

Scatter diagram with regression line
for doughball time and mixogram area
 $r = 0.554$

doughball time with viscosity. Negative non-significant coefficients were obtained for pearling with each of the other quality tests.

Table VIII contains the corresponding values for the means of the ten most promising varieties from all stations for two years. The same relationship was found with the exception of the values for pearling. Here a positive non-significant correlation was obtained for pearling with doughball time, mixogram area, and protein. A positive significant value was obtained for pearling with viscosity. The latter value is not in agreement with the previous ones. The number of individuals considered was small and, as has been previously stated, the pearling results obtained from varieties which fall within a group were erratic. Since these varieties were similar, the coefficients involving pearling relationships cannot be considered reliable.

The high correlations among protein content, doughball time, mixogram area, and viscosity, indicate that these tests are about equally reliable as indicators of quality in soft spring wheat. The variations between the coefficients calculated, however, indicate that no one of the tests alone gives a complete measure of quality as determined by the others.

In the literature reviewed earlier in this thesis reference was made to the fact that other workers have found

significant correlations between the values obtained from these tests and the values determined from actual baking quality. Unfortunately in this project no absolute measure of baking quality was determined, so there is no standard for quality which may be used in the calculation of the multiple correlation coefficient. It has, therefore, not been possible to determine the variation in baking quality which may be accounted for by variations in the other quality tests.

Correlation coefficients were also calculated for the means of the values obtained from the collaborative data from Guelph. The coefficients are presented in Table IX and scatter diagrams with regression lines are illustrated in Figure 11. A highly significant correlation was obtained for doughball time, mixogram area, and pearling percentage for 1945. The 1946 means, however, gave a highly significant relationship for mixogram area only. The coefficients for both pearling percentage and doughball time are just below significance. In both instances there is a discrepancy between laboratories for one or two values obtained. Since the number of samples is small the influence of a single value is quite marked.

It is considered justifiable to assume from the data obtained and the correlation coefficients calculated that the results of the two laboratories are in reasonable agreement. The varieties--with the exceptions mentioned--were placed in

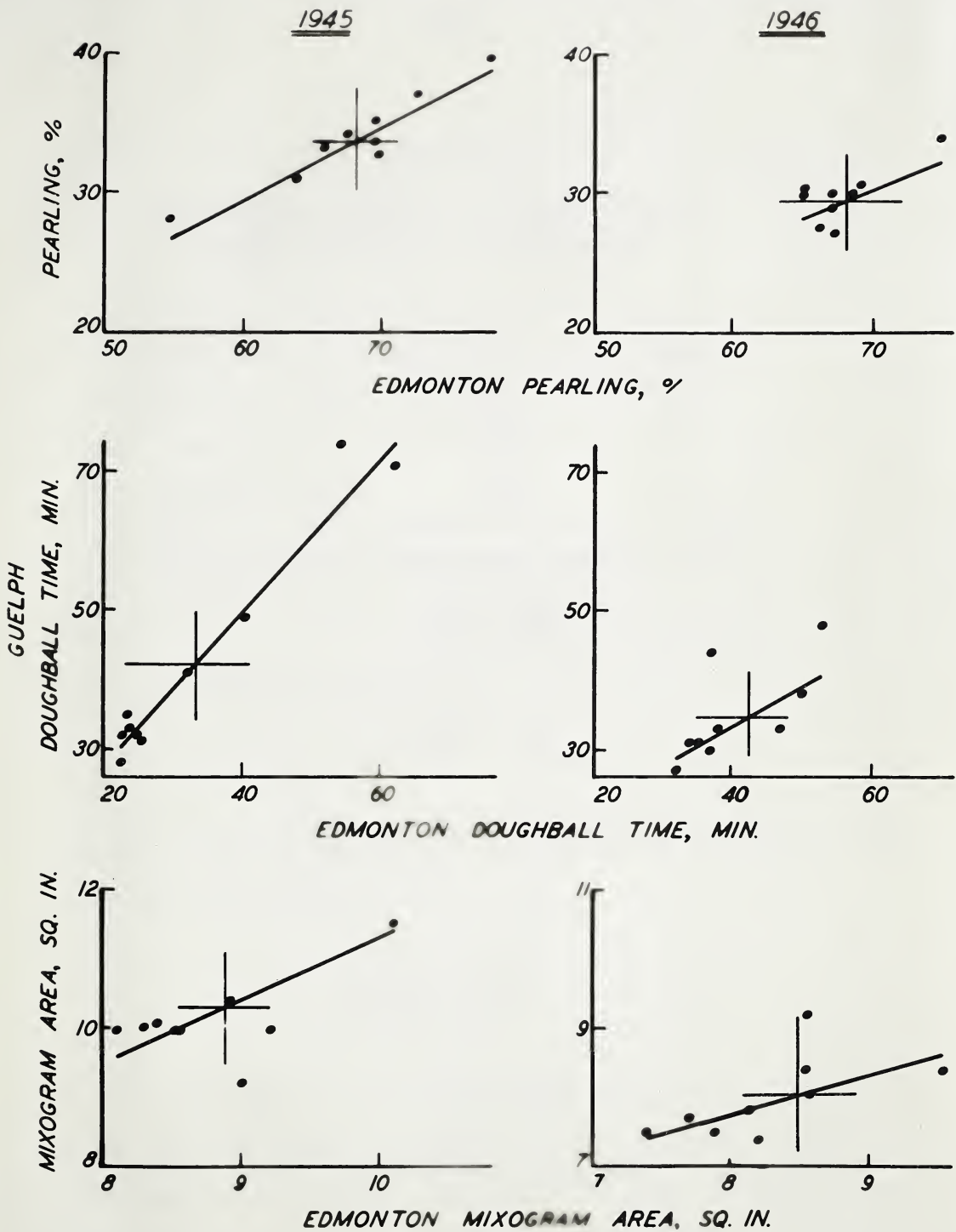


Figure 11

Scatter diagrams with regression lines for doughball time, pearling %, and mixogram area as determined at Edmonton and Guelph
(For r values see Table IX)

TABLE IX

Correlation coefficients between quality
determinations on 10 varieties at
Guelph and Edmonton laboratories

	1945	1946
Doughball time	0.978	0.627
Pearling, %	0.946	0.628
Mixogram area	0.803	0.851

Significance of correlation coefficients:

$$1\% = .765$$

$$5\% = .632$$

Except mixogram area:

$$1\% = .798$$

$$5\% = .666$$

the same order on the basis of the results obtained at Guelph
and at the University.

DISCUSSION

Of all the varieties tested, Lemhi is considered
to be the most promising under Alberta conditions. Lemhi
has a low protein content, low doughball time, low mixogram
area, low viscosity, and relatively high pearling percentage.
It yields well, has strong straw, grades well, and can be

matured without difficulty under average Alberta conditions. The Prelude x Dicklow selections, 2780-A, 3216-7, 3226-A, 3226-B, Escondido, Idaed, and Bunyip were too hard to be used for high quality cake and pastry flour. Federation, Dicklow, and Onas, although of good quality, required a long season to mature. They graded low because of this and, since their quality is, with the exception of Dicklow, not quite so good as that of Lemhi, they cannot be recommended.

The Bunyip x Dicklow selections have good quality, mature a little later than Lemhi, and tend to grade lower. It would appear advisable to use them in future breeding programs to develop earlier maturing varieties of high quality.

In the light of present knowledge, it is probably advisable to grow soft spring wheat only on irrigated land in the southern part of the province. If the protein content is to be kept down to the desired level, it is necessary to irrigate consistently. From the results obtained from the plots there can be little doubt that moisture supply is an important factor in the production of high quality soft spring wheat.

The data obtained from both the commercial survey work and the plots show that it is advisable to grow soft spring wheat on the heavier soils. Apparently the moisture-holding capacity of the land has a decided influence on the final quality of this crop. It is also recommended that it

be grown after a cereal. Annual legumes did not appear to cause an increase in protein content, but perennial legumes (alfalfa) had a decided effect. It is recommended that soft wheat should not be grown immediately following such crops.

These recommendations are made on the basis of only two years' work with soft white spring wheat so, as additional information is obtained, some modifications may be expected.

SUMMARY

1. Twenty-two varieties and selections of soft white spring wheat were tested for agronomic adaptation and quality performance under varying Alberta conditions.
2. Classification of the varieties was based mainly on yield, time of maturity, grade, protein content, doughball time, mixogram area, and viscosity.
3. The data obtained in this study placed the varieties consistently regardless of the location or year in which they were grown.
4. In a collaborative study with the Ontario Agricultural College at Guelph, ten varieties were rated similarly by both laboratories.
5. Bunyip, Escondido, Idaed, the Prelude x Dicklow selections, 2780-A, 3216-7, 3226-A, and 3226-B, were too hard

for recommendation in Alberta.

6. The Bunyip x Dicklow selections, Federation, Federation x Dicklow, Onas, and Onas 41, although of good quality, were late in maturing and low in grade.
7. Lemhi was the most satisfactory variety both as to agronomic characters and quality performance. It appeared suitable for production in Alberta.
8. It appears advisable to continue a breeding program with the object of developing earlier high-quality varieties.
9. The highest quality wheat was produced on irrigated land, with the best quality obtained where ample water was applied.
10. The lowest quality wheat was obtained from the black soils at Edmonton.
11. Quality of wheat from the gray soil area appeared fairly good on the basis of relative quality tests. Soft spring wheat cannot be recommended for this zone, however, until a more intensive quality testing program has been undertaken.
12. A survey to determine the protein content of commercially grown Lemhi wheat was carried out in the Eastern Irrigation District.

13. The protein content of soft white spring wheat grown after alfalfa was higher than that of samples grown after annual legumes and cereals.

14. The protein content of soft white spring wheat samples from light soil was relatively high. There was a gradual decrease as the moisture-holding capacity of the soil increased.

15. Correlation coefficients calculated on the means of the data indicate that, although there is a relationship between the quality tests performed no one test can give an entirely reliable measure of quality.

ACKNOWLEDGEMENTS

Although it is impractical to list by name the many people who have contributed to this project, the following should be mentioned particularly:

Dr. A. G. McCalla, under whose direction the project was carried out, for his helpful suggestions and criticisms throughout the study and during the preparation of this paper.

Mr. W. H. Waddell of the Ontario Agricultural College at Guelph, for his collaboration on the quality testing work and his cooperation in overcoming some of the technical

difficulties.

The Maple Leaf Milling Company, Ltd., for the provision of a graduate scholarship, which made possible considerable extension of the experimental work in the field of soft wheat studies.

Dr. V. C. Brink of the Department of Agronomy of the University of British Columbia, for supervising the plots grown there.

The members of the staffs of the Cereal Division and the Division of Plant Biochemistry of the Department of Plant Science who assisted so greatly with much of the routine work of the project.

The many people throughout the Brooks Irrigation District who cooperated in placing the plots and obtaining commercial samples; in particular Mr. P. D. Hargrave of the Provincial Horticulture Station, Brooks, Mr. J. D. Rawlins of the Maple Leaf Milling Company, Medicine Hat, Mr. H. T. Schmidt of the Alberta Pacific Grain Company, Brooks, Mr. V. P. Hallman, and Mr. L. L. Trimmer.

REFERENCES

1. American Association of Cereal Chemists. Cereal Laboratory Methods. Ed. 4, 264 pp. Lincoln, Nebraska. 1941.
2. CUTLER, G.H. and WORZELLA, W.W. The wheatmeal fermentation time test for measuring quality in wheat. Circ.

218. Purdue Univ., Ag. Exp. Sta., Lafayette, Ind.
1936.
3. Department of Field Crops, University of Alberta, Annual Reports 1937, 1938, 1939.
 4. FIFIELD, et al. Quality characteristics of wheat varieties grown in the western United States. U.S.D.A. Tech. Bull. #887. 1945.
 5. GARNATZ, GEO. Soft wheats and soft wheat flours, their evaluation and application. A.A.C.C. Rept., N.W. Miller, May, 1945.
 6. GUERTIN, H.E. Maple Leaf Milling Co., Ltd., Toronto, Ont. Personal Communication. June 14, 1946.
 7. HILL, A.F. Economic Botany. McGraw-Hill Book Co., Inc. N.Y. pp. 314-315. 1937.
 8. McCLUGGAGE, M.E. Factors influencing the pearling test for kernel hardness of wheat. Cer. Chem. 20(6):686-700. 1943.
 9. MORRIS, V.H., BODE, C.E., and HEIZER, H.K. The use of the mixogram in evaluating quality in soft wheat varieties. Cer. Chem. 21:49-59. 1944.
 10. _____ et al. Annual report of the Federal Soft Wheat Laboratory. U.S.D.A. Bur. Plant Ind. Ag. Exp. Sta., Wooster, Ohio. 1942.
 11. NEATBY, K.W. and McCALLA, A.G. The production and quality of cereal crops in the park and wooded areas. Univ. Alta. Bull. 30. 1938.
 12. RICHARDSON, J.E. A comparison of the qualities of flours made from white wheat varieties grown in Montana when used for making cakes and cookies. Bull. 416 Ag. Exp. Sta. Bozeman, Montana. 1943.
 13. SWANSON, C.O. and WORKING, E.B. Testing the quality of flour by the recording dough mixer. Cer. Chem. 10: 1-29. 1933.
 14. WADDELL, W.H. Personal Communication, Ontario Ag. Coll. April 3, 1946.
 15. _____ Personal Communication, Ont. Ag. Coll. April 16, 1946

16. WADDELL, et al. Annual report on winter wheat improvement in Ontario. Mim. Bull. 1944, 1945, 1946.
17. WHITESIDE, A.G.O. Personal Communication. Central Exp. Farm, Ottawa. Feb. 4, 1947.

APPENDIX

The tables presented in this section give the individual station data for all determinations.

The plot at Trimmer's was destroyed by birds in 1945 and, consequently no data for this plot are included.

Yield data for the Brooks Horticulture Station for 1946 are also omitted because of extensive bird damage.

A few of the samples, particularly Dicklow, were spoiled by mildew. Dashes have been placed in the tables where samples have been rendered unsatisfactory.

APPENDIX TABLE I

DOUGHBALL TIME (minutes)

Collaborative data from Edmonton and Guelph - 1945 and 1946

		Guelph								Edmonton									
		Brooks		Fallis		Hallman		Mean		Brooks		Fallis		Hallman		Mean		2-station mean	
Variety	N.S.N.	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946
Bunyip x Dicklow	H-43-4	36	38	32	26	32	25	33	30	24	40	26	41	21	30	24	37	28	34
Bunyip x Dicklow	H-43-8	28	37	28	27	29	28	28	31	23	37	26	33	20	33	23	34	26	32
Bunyip x Dicklow	H-43-12	32	38	31	28	32	26	32	31	21	35	28	40	20	29	23	35	28	33
Dicklow	I-33-10	33	31	29	27	32	22	35	27	22	30	27	38	24	29	24	32	29	29
Federation x Dicklow	I-45-8	29	79	32	25	32	27	31	44	21	37	34	44	22	30	26	37	28	40
Idaed	I-45-2	52	50	45	29	50	38	49	39	36	44	47	59	31	48	40	50	44	44
Lemhi	I-45-1	34	45	29	26	34	27	32	33	21	36	26	44	23	35	25	38	28	36
Onas	I-45-9	51	38	34	38	39	29	41	35	31	43	35	55	26	42	32	47	36	41
(P x D)D x (P x D)*	H-44-24		43		24		30		32		59		45		39		48		40
Red Bobs**	I-43-10	70		72		72		71		71		77		55		62		66	
2780-A	I-45-3	89	67	56	48	77	28	74	48	59	60	59	57	49	42	54	53	64	50
Plot mean		45	47	39	30	43	28			33	42	38	46	29	36				

* Data for 1946 only

** Data for 1945 only

APPENDIX TABLE II

MIXOGRAM AREA (sq. in.)

Collaborative data from Edmonton and Guelph - 1945 and 1946

Variety	N.S.N.	Guelph								Edmonton								2-station mean	
		Brooks		Fallis		Hallman		Mean		Brooks		Fallis		Hallman		Mean			
		1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946
Bunyip x Dicklow	H-43-4	11.13	9.20	10.14	8.00	8.41	6.19	9.89	7.80	9.62	9.69	9.15	7.13	6.77	7.59	8.51	8.14	9.20	7.97
Bunyip x Dicklow	H-43-8	9.38	9.08	10.73	6.64	9.76	7.36	9.96	7.69	7.93	7.88	9.13	7.57	7.34	7.66	8.13	7.70	9.04	7.70
Bunyip x Dicklow	H-43-12	10.10	9.91	10.87	5.78	9.47	7.06	10.15	7.58	8.36	10.46	8.98	5.56	7.98	7.57	8.44	7.86	9.30	7.72
Dicklow*	I-33-10	11.35	--	8.55	5.58	9.89	--	9.93	--	9.92	--	7.47	6.23	8.20	--	8.53	--	9.23	--
Federation x Dicklow	I-45-8	11.33	11.04	10.05	6.93	9.79	7.12	10.39	8.37	10.13	9.97	8.59	7.85	8.05	7.84	8.92	8.55	9.66	9.26
Idaad	I-45-2	11.73	10.48	11.30	7.43	11.48	7.17	11.50	8.36	10.51	11.57	9.95	8.36	9.90	8.67	10.12	9.53	10.81	8.94
Lemhi	I-45-1	9.38	10.82	9.80	5.47	8.41	5.84	9.20	7.38	11.72	10.90	8.08	7.38	7.21	6.33	9.00	8.20	9.10	7.79
Onas	I-45-9	10.53	9.14	10.23	6.77	9.17	6.68	9.98	7.53	7.36	7.62	8.84	8.06	8.74	6.61	8.31	7.43	9.14	7.48
(P x D)D x (P x D)**	H-44-24		9.42		7.04		7.76		8.07		10.10		8.10		7.52		8.57		8.32
Red Bobs**	I-43-10	8.63		--		--		--		9.39		8.20		8.26		8.62		--	
2780-A	I-45-3	14.26	12.50	10.24	7.61	11.11	7.55	11.87	9.22	11.69	12.16	8.90	8.87	9.88	7.59	10.16	9.54	11.01	9.38
Plot mean		10.78	10.17	10.21	6.72	9.72	6.97	--		9.66	10.04	8.73	7.51	8.23	7.49				

* Brooks and Hallman samples moulded, 1946

** Data for one year only

NOTE: Red Bobs is a hard spring variety and determinations were made with a higher spring tension.

APPENDIX TABLE III

PEARLING PERCENTAGE

Collaborative data from Edmonton and Guelph - 1945 and 1946

Variety	N.S.N.	Guelph								Edmonton								2-station mean	
		Brooks		Fallis		Hallman		Mean		Brooks		Fallis		Hallman		Mean			
		1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946
Bunyip x Dicklow	H-43-4	31.3	27.1	33.4	30.4	33.4	31.8	32.7	29.8	70.5	65.0	69.0	70.3	69.5	67.8	69.7	67.0	51.2	48.4
Bunyip x Dicklow	H-43-8	34.2	26.8	32.9	30.9	32.1	29.6	33.1	29.1	63.0	59.8	66.0	68.7	68.5	72.9	65.8	67.1	49.5	48.1
Bunyip x Dicklow	H-43-12	56.1	27.9	32.5	31.6	34.2	30.2	34.3	29.9	68.5	64.8	67.5	70.1	66.5	61.3	67.5	65.4	50.9	47.6
Dicklow	I-33-10	38.5	27.4	37.3	34.0	35.5	29.7	37.1	30.4	73.0	63.5	73.0	66.1	71.5	64.8	72.5	64.8	54.8	47.6
Federation x Dicklow	I-45-8	32.7	24.7	35.0	27.3	33.8	30.7	33.8	27.6	66.5	61.4	72.5	63.2	69.5	74.2	69.5	66.3	51.6	47.0
Idaad	I-45-3	42.0	34.3	38.0	29.6	39.1	37.7	39.7	33.9	80.0	78.2	78.0	67.4	74.5	78.9	77.5	74.8	58.6	54.4
Lemhi	I-45-1	32.3	26.9	34.2	29.9	34.9	33.4	33.5	30.1	66.5	64.8	70.0	67.9	61.0	73.2	65.8	68.6	49.6	49.4
Onas	I-45-9	36.6	29.3	34.2	29.4	34.8	33.7	35.2	30.8	70.0	70.4	69.5	64.6	69.0	72.8	69.5	69.3	52.4	50.0
(P x D)D x (P x D)*	H-44-24		27.8		27.3		30.9		28.7		79.4		63.9		67.6		70.3		49.5
Red Bobs*	I-43-10	28.2		28.7		27.3		28.1		54.0		57.5		52.5		54.7		41.4	
2780-A	I-45-3	32.5	28.9	30.6	24.6	30.0	27.8	31.0	27.1	66.5	68.0	64.0	67.3	61.0	66.6	63.8	67.3	47.4	47.2
Plot mean		34.4	28.1	35.7	29.5	35.5	31.6			67.8	67.5	68.7	67.0	66.4	70.0				

* Data for one year only.

APPENDIX TABLE IV

Days to maturity for soft spring wheat
varieties - 1945 and 1946
Determined at Edmonton only

Variety	1945	1946	Mean
Bunyip	108	117	112
Bunyip x Dicklow 4	107	119	113
Bunyip x Dicklow 8	110	116	113
Bunyip x Dicklow 12	111	120	117
Dicklow	116	120+	118+
Federation 41	111	121	116
Federation x Dicklow	110	120	115
Escondido 41	106	109	107
Idaed	102	108	105
Lemhi	106	117	111
Onas	112	118	115
Onas 41	109	118	114
Prelude x Dicklow 20	104	110	107
Prelude x Dicklow 23	105	108	107
Prelude x Dicklow 28	104	115	109
(P x D)D x (P x D) 23	105	112	108
(P x D)D x (P x D) 24	104	115	110
Red Bobs	106	109	108
2780-A	109	115	112
3216-7	107	122	115
3226-A	110	121	116
3226-B	110	123	117

APPENDIX TABLE V

Straw strength of soft spring wheat varieties - 1945 and 1946*

Variety	1945				1946					2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Mean#	Brooks	Trimmer	Edmonton	Fallis	Mean#		
Bunyip	10.0		8.0	9.0	8.0		7.0		7.5	8.0	
Bunyip x Dicklow 4	10.0	9.0	8.0	9.0	8.0	5.0	4.0	9.0	6.0	7.5	7.0
Bunyip x Dicklow 8	10.0	10.0	8.0	9.0	8.0	8.0	8.0	10.0	8.0	8.5	9.0
Bunyip x Dicklow 12	10.0	10.0	9.0	9.5	8.0	8.0	6.0	10.0	7.0	8.0	9.0
Dicklow	9.0	9.0	8.0	9.5	6.0	5.0	--	10.0	--	7.0	8.0
Federation 41	10.0		9.0	9.5	9.0		8.0		8.5	9.0	
Federation x Dicklow	10.0	10.0	8.0	9.0	7.0	6.0	7.0	10.0	7.0	8.0	8.0
Escondido 41	9.0		7.0	8.0	5.0		7.0		6.0	7.0	
Idaad	9.0	9.0	7.0	8.0	9.0	4.0	8.0	10.0	8.5	8.0	8.0
Lemhi	10.0	9.0	8.0	9.0	8.0	5.0	7.0	10.0	7.5	8.0	7.5
Onas	9.0	10.0	9.0	9.0	9.0	6.0	6.0	10.0	7.5	8.0	8.0
Onas 41	10.0		9.0	9.5	9.0		7.0		8.0	9.0	
Prelude x Dicklow 20	9.0		7.0	8.0	5.0		8.0		6.5	7.0	
Prelude x Dicklow 23	8.0		7.0	7.5	6.0		9.0		7.5	7.5	
Prelude x Dicklow 28	8.0		7.0	7.5	2.0		6.0		4.0	6.0	
(P x D)D x (P x D) 23	8.0		7.0	7.5	4.0		7.0		5.5	6.5	
(P x D)D x (P x D) 24	9.0		8.0	8.5	8.0	6.0	7.0	10.0	7.5	8.0	
Red Bobs	10.0	9.0	8.0	9.0	8.0		8.0		8.0	8.5	
2780-A	9.0	8.0	8.0	8.5	5.0	6.0	7.0	9.0	6.0	7.0	7.5
3216-7	10.0		8.0	9.0	7.0		8.0		7.5	8.0	
3226-A	10.0		8.0	9.0	6.0		6.0		6.0	7.5	
3226-B	10.0		8.0	9.0	7.0		7.0		7.0	8.0	
Plot mean	9.4	9.3	7.9		6.9	5.9	6.7	9.8			

* Straw strength was determined only at the stations listed.

Mean for Edmonton and Brooks

APPENDIX TABLE VI

Height of soft spring wheat varieties - 1945 and 1946
(measurements in inches)

Variety	1945						1946								2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations		
Bunyip	35		32		34		49			46			48		41	
Bunyip x Dicklow 4	37	41	31	28	34	34	51	46	43	47	43	32	49	46	42	40
Bunyip x Dicklow 8	33	39	31	25	32	32	46	42	39	44	42	28	45	40	38	37
Bunyip x Dicklow 12	36	38	32	25	34	33	46	44	39	45	42	27	46	40	40	37
Dicklow	39	43	35	33	37	38	49	47	43	46	44	32	48	44	42	41
Federation 41	32		30		31		48			45			46		38	
Federation x Dicklow	36	40	28	26	32	32	50	45	43	47	42	31	48	43	40	39
Escondido 41	36		31		34		45			44			44		39	
Idaæd	33	34	28	26	30	30	42	40	37	42	36	28	42	38	36	35
Lemhi	37	39	31	31	34	34	45	46	42	46	42	33	46	42	40	39
Onas	32	40	29	33	30	34	47	45	40	45	41	32	46	42	38	38
Onas 41	32		31		32		48			45			46		39	
Prelude x Dicklow 20	35		29		32		48			43			46		39	
Prelude x Dicklow 23	34		29		32		45			50			48		41	
Prelude x Dicklow 28	36		30		33		50			46			48		40	
(P x D)D x (P x D) 23	38		33		36		51			50			50		43	
(P x D)D x (P x D) 24	35		31		33		46	43	41	46	39	28	46	40	40	39
Red Bobs	37	43	31	28	34	35	49			47			48		41	39
2780-A	39	46	35	33	37	38	53	53	48	52	47	32	52	48	45	44
3216-7	38		34		36		51			47			49		43	
3226-A	41		34		37		52			48			50		44	
3226-B	39		33		36		53			47			50		43	
Plot mean	35.9	40.3	31.3	28.8			48.3	45.1	41.5	46.2	41.8	30.3				

Yield (bu. per acre) of soft spring wheat varieties - 1945 and 1946*

Variety	1945							1946							2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean all stations			
Bunyip	41.7		27.1			34.4				49.0				39.3		
Bunyip x Dicklow 4	43.6	53.4	41.5	28.1	64.4	42.5	46.2	85.2	74.2	62.4	48.7	35.5	61.2	49.2	53.7	
Bunyip x Dicklow 8	47.0	66.3	44.2	31.4	48.4	45.6	47.5	69.0	64.8	68.0	54.7	46.6	60.6	53.1	53.0	
Bunyip x Dicklow 12	49.9	49.0	41.5	28.6	67.7	45.7	47.3	82.6	69.1	68.3	54.9	43.2	63.6	53.2	55.5	
Dicklow	55.1	62.4	50.4	28.9	52.2	52.8	49.8	91.2	80.3	49.1	44.0	42.4	61.4	51.5	55.6	
Federation 41	43.5		38.4			41.0				62.2				46.0		
Federation x Dicklow	57.7	62.7	42.3	25.0	46.2	50.0	46.8	99.8	68.3	63.6	51.4	52.4	67.1	54.5	56.9	
Escondido 41	36.1		24.0			30.0				58.9				39.7		
Idaad	39.0	38.1	26.3	26.8	58.9	32.6	37.8	65.8	56.3	61.2	45.6	64.0	58.6	42.2	48.2	
Lemhi	55.0	58.8	41.4	29.7	79.3	44.1	52.8	92.0	84.6	72.9	52.4	56.4	71.7	56.4	62.2	
Onas	35.7	65.3	39.4	25.5	76.4	37.6	48.5	78.1	73.1	58.2	49.2	39.2	59.6	44.4	54.0	
Onas 41	45.7		45.7			45.7				57.2				49.5		
Prelude x Dicklow 20	25.7		29.4			27.6				42.7				32.6		
Prelude x Dicklow 23	34.1		30.7			32.4				59.0				41.3		
Prelude x Dicklow 28	34.0		27.1			30.6				66.1				42.4		
(P x D)D x (P x D) 23	24.4		25.8			25.1				61.6				37.3		
(P x D)D x (P x D) 24	38.1		30.3			34.2		58.5	57.5	67.7	37.2	35.5	51.2	45.4	46.4	
Red Bobs	35.4	44.1	28.2	27.7	57.0	31.8	38.5			56.3				40.0	41.4	
2780-A	38.4	52.9	39.2	30.7	74.6	38.8	47.2	78.6	73.5	70.7	55.0	52.4	66.0	49.4	56.6	
3216-7	45.9		32.8			39.4				60.6				46.4		
3226-A	39.5		35.0			37.2				69.4				48.0		
3226-B	36.9		36.8			36.8				65.9				46.5		
Plot mean	41.0	55.3	35.3	28.2	62.5			80.1	70.2	61.4	49.3	46.8				

* Brooks yields omitted because of excessive bird damage.

APPENDIX TABLE VIII

Weight per bushel (lb.) of soft spring wheat varieties - 1945 and 1946

Variety	1945							1946							2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	
Bunyip	64.5		65.5			65.0		63.5			64.0			63.8		64.4
Bunyip x Dicklow 4	65.0	65.5	66.5	65.0	64.0	65.8	65.2	65.0	62.0	62.0	64.0	62.0	63.0	64.5	63.0	65.1
Bunyip x Dicklow 8	65.5	65.0	66.0	64.0	64.0	65.8	64.9	64.0	62.5	63.0	63.5	63.0	62.0	63.8	63.0	64.8
Bunyip x Dicklow 12	65.5	64.5	66.0	65.5	64.0	65.8	65.1	65.0	62.0	62.0	62.5	62.0	63.0	63.2	62.9	64.8
Dicklow	62.5	62.0	64.5	59.5	60.0	63.5	61.7	57.0	56.0	54.5	57.0	59.0	60.0	57.0	57.3	60.2
Federation 41	64.0		65.0			64.5		62.5			63.0			62.8		63.6
Federation x Dicklow	65.5	63.5	65.5	64.0	63.5	65.5	64.4	63.5	61.0	61.0	63.0	61.5	61.0	63.2	61.8	64.4
Escondido 41	64.5		64.5			64.5		64.0			65.0			64.5		64.5
Idaed	65.0	64.5	65.5	66.0	64.0	65.2	65.0	65.0	62.5	62.0	65.0	62.5	63.5	65.0	63.4	65.1
Lemhi	65.0	64.0	66.0	64.0	62.5	65.5	64.3	64.5	62.0	61.0	63.5	60.5	61.5	64.0	62.2	64.8
Onas	64.5	64.0	64.5	64.5	64.0	64.5	64.3	63.5	58.0	60.0	62.0	61.0	62.5	62.8	61.2	63.6
Onas 41	64.5		65.0			64.8		63.0			62.5			62.8		63.8
Prelude x Dicklow 20	64.5		65.5			65.0		63.5			63.0			63.2		64.1
Prelude x Dicklow 23	64.5		65.5			65.0		64.0			64.0			64.0		64.5
Prelude x Dicklow 28	65.0		65.5			65.2		64.5			64.5			64.5		64.8
(P x D)D x (P x D) 23	62.5		64.5			63.5		64.5			61.5			63.0		63.2
(P x D)D x (P x D) 24	65.5		66.0			65.8		62.0	62.0	61.5	64.5	61.5	62.5	63.7	62.3	63.8
Red Bobs	65.0	65.0	66.0	66.0	64.0	65.5	65.2	63.5			65.0			64.2		64.9
2780-A	65.0	64.0	66.0	65.0	63.5	65.5	64.7	65.0	62.0	63.0	65.0	63.0	63.5	65.0	63.6	65.2
3216-7	64.0		65.0			64.5		64.0			63.5			63.8		64.2
3226-A	64.0		65.0			64.5		63.0			63.5			63.2		63.9
3226-B	64.0		65.0			64.5		63.0			63.0			63.0		63.8
Plot mean	64.5	64.2	65.3	64.4	63.4			63.5	61.0	61.0	63.2	61.6	62.2			

APPENDIX TABLE IX

Grade of soft spring wheat varieties - 1945 and 1946

Variety	1945					1946						2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.		
Bunyip	2		2			2			2			2.0	
Bunyip x Dicklow 4	2	2	2	3	4	3	2	3	3	2	3	2.5	3.0
Bunyip x Dicklow 8	2	2	2	3	3	2	2	3	3	2	3	2.0	2.5
Bunyip x Dicklow 12	2	2	2	3	3	2	2	3	3	2	3	2.0	2.5
Dicklow	3	3	3	4	4	4	4	5	4	3	4	3.5	4.0
Federation 41	3		2			3			3			3.0	
Federation x Dicklow	2	2	3	3	3	3	2	3	3	2	3	3.0	2.5
Escondido 41	2		2			2			2			2.0	
Idaed	2	2	2	2	3	2	2	3	2	2	2	2.0	2.0
Lemhi	2	2	2	3	4	2	2	3	2	2	3	2.0	2.5
Onas	3	3	3	3	4	3	3	4	3	3	2	3.0	3.0
Onas 41	2		3			3			3			3.0	
Prelude x Dicklow 20	2		2			2			3			2.0	
Prelude x Dicklow 23	2		2			2			2			2.0	
Prelude x Dicklow 28	2		2			3			2			2.0	
(P x D)D x (P x D) 23	2		1			2			4			2.0	
(P x D)D x (P x D) 24	2		2			2	2	3	2	3	3	2.0	2.0
Red Bobs	2	2	2	2	3	1			2			2.0	2.0
2780-A	2	2	2	2	3	2	2	3	2	2	2	2.0	2.0
3216-7	1		1			2			2			1.5	
3226-A	2		2			2			2			2.0	
3226-B	2		2			2			2			2.0	

APPENDIX TABLE X

Wheat protein content (%) of soft spring wheat varieties - 1945 and 1946
(Values on 13.5% moisture basis)

Variety	1945							1946									2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations			
Bunyip	14.1		14.3			14.2		12.3			12.3			12.3		13.2		
Bunyip x Dicklow 4	13.3	10.4	12.1	12.2	9.3	12.7	11.5	11.8	8.9	11.7	10.9	6.9	9.1	11.4	9.9	12.0	10.6	
Bunyip x Dicklow 8	12.5	10.1	12.1	11.7	9.5	12.3	11.2	10.9	8.9	11.3	10.4	6.9	9.2	10.6	9.4	11.5	10.3	
Bunyip x Dicklow 12	12.7	11.0	12.6	12.4	9.6	12.6	11.7	11.2	9.2	11.5	10.7	7.0	9.4	10.9	9.8	11.7	10.7	
Dicklow	12.5	10.9	11.4	10.0	8.9	12.0	10.1	12.0	8.9	12.0	10.5	6.2	8.6	11.2	9.7	11.6	10.2	
Federation 41	12.4		12.3			12.4		11.4			11.1			11.3		11.8		
Federation x Dicklow	13.3	11.4	12.9	11.9	10.9	13.1	12.1	11.3	8.6	12.3	10.9	7.0	10.4	11.2	10.1	11.7	11.0	
Escondido 41	15.5		15.2			15.4		13.7			13.1			13.4		14.4		
Idaad	14.4	13.5	14.1	13.8	11.1	14.2	13.4	12.9	10.7	12.9	11.6	9.2	9.0	12.2	11.0	13.2	12.1	
Lemhi	13.0	11.4	13.1	11.7	9.0	13.0	11.6	12.8	8.8	12.1	10.9	7.0	8.6	11.8	10.0	12.4	10.8	
Onas	12.0	10.5	12.3	11.8	9.2	12.2	11.2	11.6	10.3	11.9	11.6	7.4	9.4	11.6	10.4	11.8	10.7	
Onas 41	12.9		12.1			12.5		11.0			11.1			11.0		11.8		
Prelude x Dicklow 20	14.3		14.6			14.4		12.4			11.6			12.0		13.2		
Prelude x Dicklow 23	14.9		14.6			14.8		13.7			13.2			13.4		14.1		
Prelude x Dicklow 28	16.1		15.5			15.8		14.5			13.7			14.1		15.0		
(P x D)D x (P x D) 23	14.8		14.6			14.7		13.6			12.4			13.0		13.8		
(P x D)D x (P x D) 24	14.1		13.7			13.9		12.8	10.4	13.1	12.0	8.4	8.8	12.4	10.9	13.2	11.7	
Red Bobs	15.1	13.3	14.0	13.3	11.1	14.6	13.6	13.9			12.9			13.4		14.0	13.4	
2780-A	15.0	12.4	12.9	12.0	9.8	14.0	12.5	13.1	9.6	14.6	12.2	8.0	8.7	12.6	11.0	13.3	12.6	
3216-7	14.4		13.9			14.2		13.1			13.2			13.2		13.7		
3226-A	14.2		13.1			13.7		13.6			12.5			13.0		13.4		
3226-B	14.6		13.0			13.8		14.0			12.7			13.3		13.6		
Plot mean	13.9	11.5	13.4	12.1	9.8			12.6	9.4	12.3	11.9	7.4	9.1					

APPENDIX TABLE XI

Wheat ash (%) of soft spring wheat varieties - 1945
(Values on 13.5% moisture basis)

Variety	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations
Bunyip	1.55		1.43			1.49	
Bunyip x Dicklow 4	1.37	1.50	1.25	1.54	1.44	1.31	1.42
Bunyip x Dicklow 8	1.28	1.55	1.30	1.56	1.44	1.29	1.43
Bunyip x Dicklow 12	1.40	1.57	1.31	1.61	1.41	1.35	1.46
Dicklow	1.27	1.63	1.22	1.62	1.39	1.24	1.43
Federation 41	1.54		1.31			1.42	
Federation x Dicklow	1.31	1.58	1.44	1.66	1.53	1.38	1.50
Escondido	1.50		1.37			1.44	
Idaead	1.55	1.67	1.27	1.65	1.56	1.41	1.54
Lemhi	1.37	1.59	1.25	1.54	1.42	1.31	1.43
Onas	1.39	1.63	1.35	1.61	1.42	1.37	1.46
Onas 41	1.44		1.51			1.38	
Prelude x Dicklow 20	1.55		1.31			1.43	
Prelude x Dicklow 23	1.50		1.42			1.46	
Prelude x Dicklow 28	1.52		1.38			1.45	
(P x D)D x (P x D) 23	1.45		1.53			1.49	
(P x D)D x (P x D) 24	1.47		1.57			1.42	
Red Bobs	1.45	1.63	1.25	1.61	1.44	1.35	1.48
2780-A	1.42	1.65	1.22	1.58	1.52	1.32	1.48
3216-7	1.52		1.31			1.42	
3226-A	1.48		1.34			1.41	
3226-B	1.50		1.34			1.42	
Plot mean	1.45	1.60	1.33	1.60	1.46		

APPENDIX TABLE XII

Flour ash (%) of soft spring wheat varieties - 1945
(Values on 13.5% moisture basis)

Variety	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations
Bunyip	.43		.46			.45	
Bunyip x Dicklow 4	.42	.45	.40	.48	.54	.41	.46
Bunyip x Dicklow 8	.42	.43	.36	.48	.52	.39	.44
Bunyip x Dicklow 12	.41	.45	.36	.48	.52	.39	.44
Dicklow	.38	.41	.38	.50	.49	.38	.43
Federation 41	.41		.42			.42	
Federation x Dicklow	.37	.47	.38	.54	.54	.38	.46
Escondido	.40		.47			.43	
Idaed	.37	.46	.36	.49	.45	.36	.42
Lemhi	.41	.44	.35	.52	.50	.38	.44
Onas	.42	.42	.43	.62	.55	.42	.48
Onas 41	.53		.47			.49	
Prelude x Dicklow 20	.38		.38			.38	
Prelude x Dicklow 23	.58		.38			.48	
Prelude x Dicklow 28	.40		.42			.41	
(P x D)D x (P x D) 23	.40		.41			.40	
(P x D)D x (P x D) 24	.38		.39			.38	
Red Bobs	.36	.54	.41	.64	.49	.39	.48
2780-A	.40	.51	.42	.60	.48	.41	.50
3216-7	.41		.34			.37	
3226-A	.42		.38			.40	
3226-B	.42		.38			.41	
Plot mean	.42	.46	.40	.54	.51		

APPENDIX TABLE XIII

Doughball time (minutes) of soft spring wheat varieties - 1945 and 1946

Variety	1945							1946									2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations			
Bunyip	43		39			41		57			46			52		46		
Bunyip x Dicklow 4	24	21	26	26	28	25	25	40	30	53	43	41	50	42	43	33	35	
Bunyip x Dicklow 8	23	20	26	26	25	24	24	37	33	42	41	33	46	39	38	32	32	
Bunyip x Dicklow 12	21	20	25	28	23	23	23	35	29	48	42	40	44	38	39	31	32	
Dicklow	22	24	29	27	17	25	24	30	29	40	41	38	36	36	36	30	30	
Federation 41	27		32			29		46			50			48		38		
Federation x Dicklow	21	22	28	34	24	25	26	37	30	44	42	44	48	40	41	32	34	
Escondido 41	33		34			34		52			54			53		44		
Idaad	36	31	60	47	27	48	40	44	48	61	54	59	64	49	55	48	49	
Lemhi	21	23	27	26	27	24	25	36	35	42	41	44	55	38	42	31	34	
Onas	31	26	37	35	32	34	32	43	42	60	70	55	60	56	55	45	45	
Onas 41	32		34			33		44			82			63		48		
Prelude x Dicklow 20	32		63			47		58			54			56		52		
Prelude x Dicklow 23	35		56			46		63			75			69		58		
Prelude x Dicklow 28	32		38			35		46			65			56		46		
(P x D)D x (P x D) 23	23		31			27		43			47			45		38		
(P x D)D x (P x D) 24	22		30			26		59	39	46	46	45	53	52	48	39	43	
Red Bobs	71	55	62	77	47	66	62	71			100			86		74	69	
2780-A	59	49	59	59	43	59	54	60	42	58	93	57	57	76	61	68	58	
3216-7	42		43			42		52			82			67		55		
3226-A	41		36			38		57			92			74		56		
3226-B	37		31			34		50			64			57		46		
Plot mean	33.1	29.1	38.4	38.5	29.3			48.1	35.7	49.4	60.1	45.6	51.3					

APPENDIX TABLE XIV

Pearling percentage of soft spring wheat varieties - 1945 and 1946

Variety	1945							1946							2-year mean		
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Edmonton and Brooks	all stations
Bunyip	68.5		72.0			70.2		66.4			63.9			64.6		67.7	
Bunyip x Dicklow 4	70.5	69.5	72.0	69.0	69.5	71.2	70.1	65.0	67.8	71.9	63.6	70.3	66.6	64.3	67.5	67.7	68.7
Bunyip x Dicklow 8	63.0	68.5	68.5	66.0	72.5	65.2	67.7	59.8	72.9	68.8	62.6	68.7	69.8	61.2	67.1	63.2	67.4
Bunyip x Dicklow 12	68.5	66.5	71.5	67.5	73.0	70.0	69.4	64.8	61.3	69.8	63.2	70.1	67.4	64.0	66.1	67.0	67.5
Dicklow	73.0	71.5	74.5	73.0	75.5	73.7	73.5	63.5	64.8	63.6	59.9	66.1	68.8	61.7	65.8	62.7	68.6
Federation 41	73.0		75.5			74.2		68.6			66.8			67.7		70.9	
Federation x Dicklow	66.5	69.5	70.5	72.5	71.0	68.5	70.0	61.4	74.2	67.4	62.8	63.2	71.0	62.1	66.6	65.3	68.2
Escondido 41	64.5		69.5			66.7		62.0			63.2			62.6		64.6	
Idaad	80.0	74.5	88.0	78.0	84.0	84.0	80.9	78.2	78.9	82.4	71.7	67.4	73.9	75.0	74.7	79.5	77.9
Lemhi	66.5	61.0	76.5	70.0	79.5	71.5	70.7	64.8	73.2	68.6	64.6	67.9	71.7	64.7	68.4	68.1	69.5
Onas	70.0	69.0	76.5	69.5	71.0	73.2	71.2	70.4	72.8	72.0	68.9	64.6	65.2	69.7	68.9	71.4	69.9
Onas 41	70.5		69.5			70.0		68.5			67.9			68.2		69.1	
Prelude x Dicklow 20	79.5		79.5			79.5		74.8			79.5			77.2		78.1	
Prelude x Dicklow 23	56.0		59.0			57.5		60.9			57.0			59.0		58.2	
Prelude x Dicklow 28	75.5		74.0			74.7		73.5			65.8			69.7		72.5	
(P x D)D x (P x D) 23	56.0		61.0			58.5		57.0			52.6			54.8		56.7	
(P x D)D x (P x D) 24	69.0		--			--		79.4	67.6	66.9	63.2	63.9	67.0	71.1	68.0	70.0	67.7
Red Bobs	54.0	52.5	58.0	57.5	56.0	56.0	55.6	55.2			55.6			55.4		55.7	55.5
2780-A	66.5	61.0	66.0	64.0	71.0	66.0	65.7	68.0	66.6	66.5	60.5	67.3	69.3	64.2	68.8	65.1	66.1
3216-7	55.5		61.0			58.2		55.0			60.5			57.5		57.9	
3226-A	68.0		68.0			68.0		65.6			63.8			64.7		66.3	
3226-B	70.0		69.5			69.8		67.8			64.1			65.9		68.0	
Plot mean	67.4	66.4	70.5	68.7	72.3			65.9	70.0	69.8	63.7	67.0	69.1				

APPENDIX TABLE XV

Flour yield (%) of soft spring wheat varieties - 1945 and 1946

Variety	1945							1946									2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations			
Bunyip	60.0		60.0			60.0		53.5			53.3			53.4		56.7		
Bunyip x Dicklow 4	58.0	58.5	54.0	54.0	64.4	56.0	57.8	57.0	56.3	53.5	51.7	55.0	54.4	54.4	54.6	55.2	56.1	
Bunyip x Dicklow 8	58.5	57.0	57.5	50.0	62.8	58.0	57.2	56.0	55.0	52.0	--	--	54.4	56.0	54.4	57.0	55.9	
Bunyip x Dicklow 12	59.5	53.0	55.0	46.0	57.7	57.0	54.2	51.5	57.0	53.8	--	55.6	55.6	51.5	54.7	54.3	54.5	
Dicklow	56.0	56.0	57.5	51.0	56.6	56.7	55.4	--	--	--	--	54.4	53.1	--	53.7	56.7	54.9	
Federation 41	54.5		56.0			55.2		58.0			54.4			56.2		55.7		
Federation x Dicklow	56.5	56.0	58.5	51.0	53.9	57.5	55.2	50.5	53.9	56.0	56.3	51.3	51.9	53.4	53.3	55.4	54.2	
Escondido 41	58.0		50.0			54.0		53.0			52.5			52.8		53.4		
Idaed	57.0	52.0	64.2	47.0	--	60.6	55.0	53.8	55.5	53.0	58.2	52.5	57.5	56.0	55.1	58.3	55.1	
Lemhi	56.0	58.0	55.5	48.0	55.5	55.8	54.6	53.1	55.0	--	60.6	55.6	54.4	56.4	57.7	56.1	55.2	
Onas	56.5	50.0	56.0	56.0	58.9	56.3	55.5	38.3	57.5	51.2	53.8	50.0	52.5	46.1	50.7	51.1	52.8	
Onas 41	57.5		54.0			55.7		50.0			50.0			50.0		52.8		
Prelude x Dicklow 20	57.0		60.5			58.7		55.0			61.8			58.4		58.6		
Prelude x Dicklow 23	65.0		58.0			61.5		56.9			56.3			56.6		59.0		
Prelude x Dicklow 28	40.0		53.5			46.7		50.0			58.8			54.4		50.0		
(P x D)D x (P x D) 23	59.0		57.0			58.0		47.9			54.4			50.2		53.9		
(P x D)D x (P x D) 24	54.5		57.0			56.5		56.3	55.0	55.0	52.5	55.0	54.4	54.4	54.7	55.4	55.0	
Red Bobs	63.0	61.0	62.0	58.0	60.0	62.5	60.8	68.0			58.8			63.4		63.0	61.5	
2780-A	56.5	58.5	54.0	45.0	51.1	55.2	53.0	54.5	51.5	56.0	52.5	56.3	55.0	53.5	54.3	54.3	53.7	
3216-7	58.0		56.0			57.0		--			61.3			--		59.1		
3226-A	55.0		55.0			55.0		54.5			57.5			56.0		55.5		
3226-B	56.5		57.5			57.0		55.0			58.8			56.9		57.0		
Plot mean	56.9	56.0	56.7	50.1	57.9			53.6	55.2	53.8	55.9	53.9	54.3					

APPENDIX TABLE XVI

Flour protein content (%) of soft spring wheat varieties - 1945 and 1946
(Protein content on 13.5% moisture basis)

Variety	1945							1946									2-year mean Edmonton and Brooks	2-year mean all stations
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations			
Bunyip	13.5		12.9			13.2		10.3			10.4			10.4		11.8		
Bunyip x Dicklow 4	12.1	8.4	10.6	10.7	7.9	11.4	9.9	10.8	7.0	10.3	9.0	6.2	7.6	9.9	8.5	10.6	9.1	
Bunyip x Dicklow 8	12.4	9.2	12.1	10.6	8.8	12.2	10.6	9.8	7.8	10.1	8.8	5.8	7.3	9.3	8.2	10.8	9.3	
Bunyip x Dicklow 12	11.2	9.6	10.3	10.7	7.1	10.8	9.8	10.5	7.5	10.5	9.1	5.4	7.9	9.8	8.5	10.3	9.1	
Dicklow	12.2	9.8	10.6	8.7	8.1	11.4	9.9	--	--	--	--	5.5	7.6	--	--	--	8.9	
Federation 41	12.4		10.9			11.6		11.6			10.6			11.1		11.4		
Federation x Dicklow	12.1	9.6	11.4	10.5	9.5	11.7	10.6	11.0	7.4	10.2	9.2	6.2	7.6	10.1	8.6	10.9	9.5	
Escondido 41	11.5		13.5			12.5		12.1			10.4			11.2		11.8		
Idaad	12.4	11.6	12.6	11.5	9.0	12.5	11.4	10.8	8.3	11.0	9.7	7.7	8.1	10.2	9.3	11.4	10.2	
Lemhi	10.6	9.1	11.3	9.8	7.6	10.9	9.7	11.1	7.0	9.8	9.5	5.5	7.3	10.3	8.4	10.6	9.0	
Onas	11.3	9.6	10.2	10.9	8.2	10.7	10.0	9.9	8.0	9.7	10.4	6.0	7.7	10.2	8.6	10.4	9.3	
Onas 41	12.5		11.4			12.0		9.7			9.6			9.6		10.8		
Prelude x Dicklow 20	11.5		11.7			11.6		10.8			10.3			10.5		11.0		
Prelude x Dicklow 23	12.8		13.6			13.2		11.2			12.5			11.8		12.5		
Prelude x Dicklow 28	14.1		14.9			14.5		13.5			11.8			12.6		13.6		
(P x D)D x (P x D) 23	14.2		13.9			14.0		12.2			13.2			12.7		13.4		
(P x D)D x (P x D) 24	12.6		12.6			12.6		10.6	9.1	11.9	11.7	7.0	7.9	11.2	9.7	11.9	10.4	
Red Bobs	14.4	12.6	13.6	13.4	10.1	14.0	12.8	13.2			12.8			13.0		13.5	12.9	
2780-A	13.1	10.8	13.9	11.3	8.4	13.5	11.5	11.7	8.4	10.9	10.9	6.2	7.9	11.3	9.4	12.4	10.3	
3216-7	13.0		12.0			12.5		--			11.3			--		11.9		
3226-A	12.7		11.7			12.2		10.7			11.3			11.0		11.6		
3226-B	13.1		11.7			12.4		12.2			11.4			11.8		12.1		
Plot mean	12.5	10.1	12.2	10.8	8.5			11.2	7.8	10.6	10.7	6.2	7.7					

APPENDIX TABLE XVII

Mixogram area (sq. in.) of soft spring wheat varieties - 1945 and 1946

Variety	1945							1946							2-year mean Edmonton and Brooks	2-year mean all stations	
	Brooks	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks	Mean all stations	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean Edmonton and Brooks			Mean all stations
Bunyip	11.31		10.85			11.08		10.70			10.79			10.74		10.91	
Bunyip x Dicklow 4	9.62	6.77	9.05	9.15	6.23	9.34	8.16	9.69	7.59	10.41	9.41	7.13	8.38	9.55	8.77	9.44	8.49
Bunyip x Dicklow 8	7.93	7.34	10.82	9.13	8.52	9.38	8.95	7.88	7.66	8.72	8.98	7.57	7.95	8.43	8.13	8.90	8.41
Bunyip x Dicklow 12	8.36	7.98	8.87	8.98	6.08	8.61	8.05	10.46	7.57	10.16	9.49	5.56	7.82	9.98	8.51	9.29	8.30
Dicklow	9.92	8.20	9.29	7.47	6.84	9.61	8.34	--	--	--	--	6.23	5.97	--	--	--	--
Federation 41	10.39		9.38			9.88		10.84			10.06			10.45		10.17	
Federation x Dicklow	10.13	8.05	9.93	8.59	8.31	10.03	9.00	9.97	7.84	10.46	10.64	7.85	8.11	10.30	9.15	10.19	9.08
Escondido 41	9.54		11.72			10.63		10.62			10.13			10.37		10.50	
Idaad	10.51	9.90	11.34	9.95	7.29	10.92	9.80	11.57	8.67	10.21	10.38	8.36	8.46	10.98	9.61	10.91	9.69
Lemhi	11.72	7.21	9.88	8.08	5.85	10.80	8.55	10.90	6.33	8.61	9.88	7.38	8.02	10.39	8.52	10.59	8.53
Onas	7.36	8.74	8.67	8.84	7.58	8.02	8.24	7.62	6.61	8.39	9.52	8.06	8.26	8.57	8.08	8.29	8.15
Onas 41	9.51		10.15			9.83		8.80			9.08			8.94		9.38	
Prelude x Dicklow 20	8.46		9.28			8.87		9.57			9.93			9.75		9.51	
Prelude x Dicklow 23	8.98		13.08			11.03		10.10			12.93			11.52		11.27	
Prelude x Dicklow 28	12.39		14.90			13.64		12.43			12.23			12.33		12.99	
(P x D)D x (P x D) 23	10.82		10.77			10.79		11.23			13.90			12.57		11.68	
(P x D)D x (P x D) 24	9.07		9.87			9.47		10.10	7.52	9.93	10.69	8.10	7.98	10.40	9.05	9.93	9.16
Red Bobs	--		--			--		--			--			--		--	
2780-A	11.89	9.88	14.05	8.90	7.97	12.87	10.50	12.16	7.59	11.59	12.82	8.87	8.92	12.49	10.33	12.68	10.40
3216-7	12.67		11.98			12.32		--			11.34			--		12.00	
3226-A	11.39		12.29			11.85		10.33			12.69			11.51		11.68	
3226-B	11.87		10.87			11.37		11.69			11.92			11.81		11.59	
Plot mean	10.17	8.23	10.81	8.79	7.19			10.35	7.49	9.83	10.84	7.51	7.99				

APPENDIX TABLE XVIII

Viscosity of soft spring wheat varieties. Determined for 1946 only

Variety	Brooks	Trimmer	Hallman	Edmonton	Fallis	U.B.C.	Mean, Brooks and Edmonton	Mean, all stations
Bunyip	69			129			99	
Bunyip x Dicklow 4	82	54	128	82	26	64	82	73
Bunyip x Dicklow 8	67	59	94	98	31	60	83	68
Bunyip x Dicklow 12	96	52	120	100	28	60	97	76
Dicklow	--	--	--	--	25	41	--	--
Federation 41	107			127			117	
Federation x Dicklow	104	63	106	96	53	79	100	83
Escondido	120			106			113	
Idaed	130	84	150	105	71	83	118	104
Lemhi	105	54	78	120	36	70	115	77
Onas	70	43	83	141	41	67	106	73
Onas 41	87			107			97	
Prelude x Dicklow 20	142			89			116	
Prelude x Dicklow 23	151			156			154	
Prelude x Dicklow 28	153			120			136	
(P x D)D x (P x D) 23	150			164			157	
(P x D)D x (P x D) 24	85	66	88	132	23	52	108	74
Red Bobs	185			190			187	
2780-A	145	47	141	147	47	89	146	103
3216-7	--			148			148	
3226-A	92			201			146	
3226-B	142			156			149	
Plot mean	114.1	58.0	109.7	129.2	38.1	66.5		

APPENDIX TABLE XIX

Rust and mildew as observed at Brooks
Horticulture Station - 1946
Values are based on proportion of 10.0.
(10.0 indicates a heavy infection)

Variety	Rust	Mildew
Bunyip	9.0	2.0
Bunyip x Dicklow 4	5.5	5.0
Bunyip x Dicklow 8	4.5	5.0
Bunyip x Dicklow 12	6.0	3.5
Dicklow	6.0	2.0
Federation 41	3.0	9.0
Federation x Dicklow	3.0	6.0
Escondido 41	8.0	3.0
Idaed	9.0	2.5
Lemhi	4.0	3.0
Onas	4.0	4.5
Onas 41	2.0	7.5
Prelude x Dicklow 20	8.5	6.0
Prelude x Dicklow 23	9.0	3.5
Prelude x Dicklow 28	7.5	4.0
(P x D)D x (P x D) 23	5.0	2.0
(P x D)D x (P x D) 24	6.5	3.0
Red Bobs	7.0	2.0
2780-A	1.5	3.0
3216-7	1.5	1.0
3226-A	2.5	2.0
3226-B	2.0	2.0

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